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Results of the Atlantic mackerel (*Scomber scombrus* L.) egg surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011

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ABSTRACT

This document presents the results of the Atlantic mackerel (*Scomber scombrus* L.) egg surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011. For each of these surveys, very low abundances of eggs of less than 10 eggs/m^2 were measured at more than 40% of the sampled stations. Abundances ranged from 0.0 to 785.1 eggs/m^2 for respective averages of 95.3 and 56.1 eggs/m^2 in 2008 and 2009 and of 20.0 and 30.0 eggs/m^2 in 2010 and 2011. The highest egg abundances were measured at the stations between Îles-de-la-Madeleine, baie des Chaleurs, and the northeast coast of New Brunswick. It is also at these stations that water temperatures were the highest. In 2008 and 2009, total egg productions were evaluated at 4.18×10^{12} and 1.90×10^{12} eggs and in 2010 and 2011, at 6.48×10^{11} and 9.58×10^{11} eggs. These egg productions are associated with an index of the spawning stock biomass ranging from 25,960 t to 99,631 t. This index has significantly decline from the mid-1990s and the values calculated since 2005 are among the lowest of the historical series. In order to verify if these low values were associated with a displacement of the main spawning activities outside the Gulf of St. Lawrence, an additional egg survey was conducted on the Scotian Shelf and on a portion of the southern coast of Newfoundland in 2009. The low egg abundances measured during this survey suggest that the spawning biomass was not important and that the low values measured in the southern Gulf of St. Lawrence represent a real decline in abundance. All the results presented in this document suggest a reduction of the Total Allowable Catch (TAC).

RÉSUMÉ

Ce document présente les résultats des relevés des œufs de maquereau bleu (*Scomber scombrus* L.) réalisés dans le sud du golfe du Saint-Laurent de 2008 à 2011. Pour chacun de ces relevés, de très faibles abondances d'œufs de moins de 10 œufs/m^2 ont été mesurées à plus de 40 % des stations échantillonnées. Les abondances ont varié de 0,0 à 785,1 œufs/m^2 pour des moyennes respectives de 95,3 et 56,1 œufs/m^2 en 2008 et 2009 et de 20,0 et 30,0 œufs/m^2 en 2010 et 2011. Les abondances d'œufs les plus élevées ont été mesurées aux stations situées entre les Îles-de-la-Madeleine, la baie des Chaleurs et la côte nord-est du Nouveau-Brunswick. C'est aussi à ces stations que les températures de l'eau étaient les plus élevées. En 2008 et 2009, les productions totales d'œufs ont été évaluées à 4,18 x 10^{12} et 1,90 x 10^{12} œufs et en 2010 et 2011, à 6,48 x 10^{11} et 9,58 x 10^{11} œufs. À ces productions d'œufs sont associées un indice de la biomasse reproductrice variant de 25 960 t à 99 631 t. Cet indice a connu une chute importante à partir du milieu des années 1990 et les valeurs calculées depuis 2005 sont parmi les plus faibles de toute la série historique. Afin de vérifier si ces faibles valeurs étaient associées à un déplacement des principales activités de ponte à l'extérieur du golfe du Saint-Laurent, un relevé additionnel des œufs a été réalisé sur le plateau néo-écossais et une portion de la côte sud de Terre-Neuve en 2009. Les faibles abondances d'œufs mesurées lors de ce relevé suggèrent que la biomasse reproductrice était peu abondante et que les faibles valeurs mesurées dans le sud du golfe du Saint-Laurent représentent une baisse réelle d'abondance. Tous les résultats présentés dans ce document suggèrent une réduction du Total Admissible des Captures (TAC).

1. INTRODUCTION

The calculation of a biomass index for the Atlantic mackerel (*Scomber scombrus* L.) stock that spawns in the southern Gulf of St. Lawrence is realised using an egg survey. This index is used since 1983 to follow the evolution of the abundance of the Atlantic mackerel in NAFO Subareas 3-4. In 2012, the index was also used to calibrate a Sequential Population Analysis (SPA).

The last Canadian assessment of the Atlantic mackerel dates back to 2008 and was based on the results of the 2007 egg survey (Grégoire *et al.* 2008). The preliminary results of the 2008 survey were presented in 2009 at the joint Canada / United States assessment. This document presents the complete results of the surveys conducted in 2008, 2009, 2010, and 2011.

2. MATERIAL AND METHODS

2.1 SAMPLING AT SEA

As requested by industry, the at-sea sampling plan for the 2008 and 2009 surveys was modified in order to include (as in 2006 and 2007) five stations in the Northumberland Strait (Figure 1). Plankton was collected using a Bongo sampler (Posgay and Marak 1980) equipped with two 333-micron mesh Nitex nets with a 61 cm opening. A General Oceanics™ flowmeter was attached near the opening of each net in order to measure the volume of filtered water. The tows, which lasted a minimum of 10 minutes, were made following a saw-tooth pattern (Hempel 1973) between the surface and a maximum depth of 50 m, or up to 5 m from the bottom for shallower stations. The tow patterns and positioning of the nets in the water column were monitored in real time using electronic equipment (BIONET™) attached to the sampler's frame. A CTD (Sea-Bird SBE-19) probe, also attached to the sampler's frame, provided temperature and salinity patterns in the sampled portion of the water column.

Back on the deck, the nets were hung and washed with salt water. Plankton samples from one of the two nets were kept in a diluted solution (4-5%) of formaldehyde (Hunter 1985) and the samples from the other net, in concentrated ethanol (100%).

2.2 LABORATORY ANALYSES

Plankton sorting (formaldehyde) was carried out at the Maurice Lamontagne Institute laboratory (Fisheries and Oceans, Mont-Joli) in the fall following each survey. Each sample was fractionated based on the Van Guelpen beaker split method (Van Guelpen *et al.* 1982). The mackerel egg and larvae identification criteria were taken from the work conducted by Fritzsche (1978), Elliott and Jimenez (1981), and by Fahay (1983).

2.3 CALCULATION OF THE EGG ABUNDANCE (N/M^2) BY STATION

The egg counts by stage of development (Girard 2000) were recorded, validated and standardized according to the volume of filtered water (m^3) and converted in abundance (number) by m^2 considering the maximum sampled depth (m). These abundances were analyzed according to the water temperature based on the approach proposed by Perry and Smith (1994).

2.4 CALCULATION OF THE INCUBATION TIMES (HR)

The egg incubation times of stages one and five (stage 1 broken or dead) were calculated according to the Lockwood *et al.* (1977) model for Northeast Atlantic mackerel. This model is defined as follows:

$$I = (e^{[-1.61 \cdot Ln(T) + 7.76]})$$

where T is the mean temperature (°C) for the first 10 meters of water (area in the southern Gulf of St. Lawrence at the time of the survey that is usually above the thermocline).

2.5 CALCULATION OF THE DAILY EGG PRODUCTION (N/M^2) BY STATION

The daily egg production (n/m^2) per station is defined as follows:

$$\frac{\text{Abundance (stages 1 and 5) (n/m}^2)}{\text{Incubation time (hr)}} \bullet 24\ hr$$

2.6 CALCULATION OF THE DAILY EGG PRODUCTION (N/M^2) FOR THE ENTIRE SAMPLED AREA

The sampled area has three adjoining stratums that were defined by Ouellet (1987) based on the statistical approach proposed by Dalenius and Hodges (1959). The surface of each of these stratums was used as a weighting factor based on the equations from a random stratified sampling plan (Cochran 1977). The daily egg production for the entire sampled area corresponds to the weighted mean from the daily productions (n/m^2) calculated for each station.

The daily egg production for the entire sampled area was also calculated using kriging. The choice of the variogram, the calculation of the semivariance and the ordinary point kriging were realised with the GS$^+$ software (Robertson 1998). A correction factor was applied for variograms constructed without extreme values. The number of points to be added to the research neighbourhood was set at 16, and there were no restrictions applied to the search radius. Kriging averages and variances were calculated using the EVA II software (Petitgas and Lafont 1997).

2.7 CALCULATION OF THE PROPORTION OF EGGS SPAWNED DAILY

The proportion of eggs spawned at the median date of the surveys was calculated using a density curve taken from a logistic model describing the daily changes of the gonadosomatic index (GSI). This approach was preferred to the normal density curve (of the same range and with a maximum occurring always at the same date) that was used in the past (Grégoire *et al.* 2008). The logistic model is described as follows:

$$y = y_0 + \frac{a}{\left[1 + \left(\frac{x}{x_0}\right)^b\right]}$$

where:

y= daily average of the gonadosomatic index

x= day of the year

and y_0, a, x_0 and b, the parameters to be fitted

The same logistic model was used over the years. However, a correction was applied to the 1991 model in order to force the presence of a plateau for the values measured at the beginning of the season.

2.8 CALCULATION OF THE TOTAL ANNUAL EGG PRODUCTION

Total annual egg production was calculated by dividing the product of the mean daily egg production and the surface of the area sampled by the proportion of eggs spawned at the median date of the surveys.

2.9 CALCULATION OF THE SPAWNING BIOMASS INDEX

The spawning biomass index (t) was calculated according to the basic model proposed by Saville (1977). The Total Egg Production Method (TEPM), which is an application of this model, is defined as follows:

$$B = \frac{P \cdot A \cdot W}{S \cdot F \cdot R \cdot 10^6}$$

where:

B = Spawning biomass index (t)

P = Mean daily egg production (nb/m^2) per station (stratified or kriging average)

A = Area (m^2) of the zone sampled (6.945 x 10^{10} m^2)

W = Mean weight (g) of a fish

S = Proportion of eggs spawned at the median date of a survey

F = Fecundity of females (Pelletier 1986)

R = Sex ratio (proportion of females in the biological samples)

10^6 = Factor for converting grams into tonnes

2.10 ATLANTIC MACKEREL LARVAE ABUNDANCE

The abundances of mackerel larvae were calculated in numbers per m^2 and their distribution are presented for the surveys conducted since 1983.

3. RESULTS

3.1 SAMPLING PLAN

The 2008 survey was conducted between 21 and 29 June, the surveys of 2009 and 2010 between 13 and 21 June, and the 2011 survey between 11 and 19 June (Figure 2). Surveys of 2008 and 2010 started at stations 4.5, the 2009 survey at station 2.2 and the 2011 survey at station 9.5. In 2008, 12 stations could not be sampled because of the poor weather conditions. All stations were sampled in 2009, 2010 and 2011, but problems with the CTD probe were met at two stations (8.6 and 8.7) in 2009 and at one station (1.1) in 2011.

3.2 EGG ABUNDANCE (N/M^2) BY STATION

Very low egg abundances, less than 10 eggs/m^2, have been measured at 42% of the stations sampled in 2008 compared to 66% and more for following surveys. Abundances have ranged from 0.0 to 785.1 eggs/m^2 for respective averages of 95.3 and 56.1 eggs/m^2 in 2008 and 2009, and of 20.0 and 30.0 eggs/m^2 in 2010 and 2011 (Table 1). The highest abundances were measured at the stations located between the Magdalen Islands and Baie des Chaleurs in 2008 and 2009, at the entrance of Baie des Chaleurs in 2010 and in the estuary of the Miramichi River in 2011 (Figure 3). Warmer temperatures are associated with these stations. Very few eggs were found in the Northumberland Strait in 2008 and 2009. Overall, the egg abundances of the 2008-2011 surveys are much lower than those of the surveys realised from the 1980s to the mid-1990s (Appendix 1).

During the 2008-2011 surveys, water temperatures in the 0-10 m layer varied from 6.0 to 15.6°C for respective averages of 12.5 and 10.8°C in 2008 and 2009 and of 9.3 and 9.5 °C in 2010 and 2011 (Table 2).

In 2008 and 2009, the egg abundances of 300 eggs/m^2 and more were measured at the stations where water temperatures ranged between 10.0 and 13.0 °C (Figures 4A and 4B). Almost 50% of the abundances were associated with temperatures below 12.0 °C (Figures 4C and 4D). In 2010 and 2011, the highest abundances, of 265 and 776 eggs/m^2, were associated with temperatures of 10.9 and 11.3 °C (Figures 5A and 5B). For these two surveys, the egg abundances were strongly related to temperatures above 11.0 °C (Figures 5C and 5D).

More than 50% of the abundances consisted of eggs from stages of development 1 and 5 (Figure 6A). Eggs of the other stages accounted for less than 20%. Stages 1 and 5 abundance has been increasing since 2008 contrary to those of stage 4. An opposite relationship ($p<0.0001$) has been determined between the annual proportion (%) of eggs from stages 1 and 5 and the average temperature of the 0-10 m layer of water (Figure 6B).

3.3 INCUBATION TIMES (HR)

Incubation times varied from 28.1 to 130.7 hr for respective averages of 42.1 and 52.2 hr in 2008 and 2009, and of 69.0 and 65.8 hr in 2010 and 2011 (Table 3). The higher incubation times of 2010 and 2011 were caused by colder temperatures (Table 2).

3.4 DAILY EGG PRODUCTION (N/M^2) BY STATION AND FOR THE ENTIRE SAMPLED AREA

The daily egg productions by station calculated between 2008 and 2011 ranged from 0 to 392.2 eggs/m^2 for respective averages of 54.1 and 27.6 eggs/m^2 in 2008 and 2009 and 9.2 and 14.5 eggs/m^2 in 2010 and 2011 (Table 4). Similar averages were obtained taking into account the three strata of the sampling area (Table 5).

The parameters of the variograms used to calculate the daily egg productions by kriging are presented in Table 6. The spherical model has been used in most of the cases and the coefficients of determination of each model ranged from 0.827 to 0.993. The daily egg productions calculated by kriging (Table 7) are similar to those calculated for all the strata (Table 5). However, the variances calculated by kriging are lower.

3.5 GONADOSOMATIC INDEX AND PROPORTION OF EGGS SPAWNED DAILY

The maximum values of the gonadosomatic index were observed June 12th (day of the year 164) in 2008 (Figure 7A), June 13th (day 164) in 2009 (Figure 8A) and June 9th (day 160) in 2010, and 2011 (Figures 9A and 10A). Values of less than 2% (end of the spawning) were measured from July 1st (day 182).

Based on the logistic model, the proportions of eggs spawned at the survey's median dates and used to calculate the total egg productions were 0.0543 and 0.0361 in 2008 and 2009 compared to 0.0321 and 0.0339 in 2010 and 2011 (Table 8; Figures 7B, 8B, 9B, and 10B). Median dates of the 2008, 2010, and 2011 surveys correspond to the peaks of the spawning while the 2009 peak occurred a few days after the median date of the survey. The spawning durations were 22 and 30 days in 2008 and 2009 compared to 32 and 31 days in 2010 and 2011 (Table 9).

3.6 TOTAL ANNUAL EGG PRODUCTION AND INDEX OF THE SPAWNING BIOMASS

The total egg productions of 2008 and 2009 were evaluated respectively at 4.18×10^{12} and 1.90×10^{12} eggs (Table 10). Lower productions, of 6.48×10^{11} and 9.58×10^{11} eggs, were measured in 2010 and 2011. Between 2008 and 2011, the proportions of females in the biological samples ranged from 0.5084 to 0.5144 and the mean weights of a fish, from 335.5 to 350.4 g (Table 11). Mean female fecundities calculated from the same samples ranged from 481,941 to 530,018 eggs.

The spawning biomass indices were evaluated at less than 100,000 t since 2005. The historic minimum was measured in 2010 with 25,960 t (Table 12; Figure 11). These indices are similar to those calculated from the kriged daily egg productions (Figure 11).

3.7 LARVAE DISTRIBUTION AND ABUNDANCE

In 2008 and 2009, mackerel larvae were found at several stations in the south of the area sampled. However, very few larvae were found during the 2010 and 2011 surveys (Figure 12) as well as for the surveys conducted in the 1990s and between 2000 and 2005 (Appendix 2).

4. CONCLUSION

Since the beginning of the survey series in 1983 (and including the 1979 survey), the mackerel spawning biomass index increased significantly on three occasions. These increases were linked to the arrival of the dominant 1982, 1988, and 1999 year-classes. A large decrease of the spawning biomass index was measured in the mid-1990s. This index also reached historical minimum values since 2005.

The low egg abundances measured in 2009 during the Scotian Shelf and the southern coast of Newfoundland survey (Grégoire *et al.* 2012) exclude the possibility that a significant portion of the Canadian contingent of Atlantic mackerel spawns outside the Gulf of St. Lawrence. The low values of the spawning biomass index measured in the southern Gulf of St. Lawrence suggest a real decline in abundance. Pending the arrival of a strong recruitment, these results suggest also that the catches should be reduced over the next years.

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TABLES

Table 1. Egg abundance (developmental stages 1 and 5) (n/m^2) of Atlantic mackerel for the stations of the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.

	STATIONS																		
	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	2.5	2.6	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8
STRATE / *STRATUM*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1
LONGITUDE	-60.92	-60.75	-60.75	-60.75	-60.75	-61.25	-61.25	-61.25	-61.25	-61.25	-61.25	-61.77	-61.75	-61.75	-61.75	-61.75	-61.83	-61.75	-61.75
LATITUDE	46.83	47.17	47.50	47.83	48.17	46.50	46.83	47.17	47.50	47.83	48.17	45.83	46.17	46.50	46.83	47.17	47.58	47.83	48.17
1979	8.4	87.9	0.0	0.0	1.1	86.2	38.4	15.1	105.1	59.7	0.1	122.1	7.5	84.3	136.6	49.6	306.1	65.4	0.3
1983	2.4	4.4	60.8	23.9	0.5	37.5	2.7	30.7	87.2	132.9	8.2	76.4	58.2	78.5	12.8	164.2	61.9	---	2.7
1984	40.6	79.9	0.0	2.2	0.0	67.9	35.8	16.8	14.1	1.7	6.9	82.9	31.7	87.1	60.1	7.8	313.1	10.0	0.9
1985	8.9	29.5	0.0	0.0	0.8	74.6	19.5	104.8	7.7	0.0	0.0	63.6	97.1	176.5	186.8	229.7	129.4	186.9	302.9
1986	---	---	0.0	0.0	0.0	---	---	---	284.3	666.3	0.0	---	48.4	609.6	183.4	271.7	1248.7	960.3	0.0
1987	39.9	158.1	40.5	1.3	3.7	172.5	246.0	213.5	121.6	228.1	28.5	104.8	209.4	372.2	174.5	194.6	148.2	93.2	93.7
1988	378.3	56.6	0.0	0.0	0.0	221.5	227.3	117.0	4.0	0.0	0.5	508.5	121.6	108.4	167.6	526.0	65.5	0.0	0.0
1989	0.4	23.9	2.8	0.0	0.0	31.0	10.0	43.8	4.5	1.4	7.5	124.8	128.5	46.6	37.8	43.1	112.7	2.3	0.0
1990	44.9	15.0	0.0	0.0	0.0	171.2	8.2	11.4	3.4	0.0	0.0	99.5	65.9	52.7	15.6	24.8	0.0	4.9	0.0
1991	61.5	4.7	0.0	0.0	0.0	110.2	14.3	0.0	2.3	---	0.0	135.0	125.0	135.0	8.8	16.7	4.4	450.7	0.0
1992	4.0	28.6	23.7	0.0	0.0	32.2	6.1	48.3	5.1	1.7	0.0	27.4	184.9	93.6	45.0	23.6	0.9	14.0	0.6
1993	85.8	23.6	0.0	0.0	0.0	59.7	11.2	11.0	0.9	0.5	0.0	185.2	50.3	20.4	16.2	40.0	6.7	1.2	0.0
1994	3.0	27.2	0.0	0.0	0.0	8.2	6.0	4.8	0.0	0.0	0.0	56.8	1.9	22.4	9.5	0.6	0.2	0.0	0.0
1996	25.6	59.2	0.2	0.0	0.0	9.7	27.4	20.3	54.4	0.0	0.0	18.3	9.5	95.4	30.4	64.2	5.0	1.1	0.0
1998	14.3	24.9	22.6	0.0	0.0	7.3	24.1	181.1	1.5	0.3	0.2	22.5	46.9	18.0	61.3	54.8	0.0	---	0.0
2000	2.6	3.5	0.0	0.0	0.0	5.5	4.6	0.0	0.0	0.0	0.0	40.9	8.2	37.2	---	1.3	0.3	0.0	0.0
2002	18.4	10.4	0.9	0.0	0.0	20.8	17.7	5.4	0.2	0.0	0.0	59.9	104.9	123.0	66.0	9.2	0.8	0.0	0.0
2003	20.4	29.8	0.4	0.2	0.0	166.7	92.2	0.0	0.0	0.0	0.0	49.8	180.9	106.3	60.3	1.3	0.0	0.0	0.0
2004	36.7	7.2	0.0	0.0	0.0	4.2	18.8	1.4	0.0	0.0	0.0	154.5	13.0	20.5	9.2	0.4	0.0	0.0	0.0
2005	91.0	24.2	0.6	---	---	14.9	11.2	81.2	6.3	0.2	0.0	1.5	14.1	39.4	35.3	68.6	0.0	0.0	0.0
2006	0.0	0.0	2.9	0.0	0.2	0.4	1.0	0.2	1.7	8.7	0.6	5.9	0.3	0.0	0.0	2.9	1.2	0.6	0.0
2007	2.3	1.4	5.9	0.0	0.0	2.4	1.4	0.0	0.0	0.0	0.0	69.7	0.2	20.5	11.8	8.3	0.0	0.0	0.0
2008	1.3	---	---	---	---	1.9	1.1	2.2	0.0	0.2	0.0	1.0	0.2	0.7	0.0	14.9	0.1	67.8	0.0
2009	2.8	2.1	0.0	0.0	0.0	0.0	9.0	2.7	0.8	0.0	0.0	3.3	1.2	1.7	3.0	0.8	2.3	351.8	1.3
2010	3.3	3.3	0.0	0.0	0.0	1.1	7.2	0.0	0.0	0.0	0.0	3.7	0.4	4.2	2.5	0.0	0.0	0.0	0.0
2011	---	0.0	0.0	0.0	0.0	0.5	0.0	1.0	0.0	0.0	0.0	2.2	0.8	2.4	2.0	0.4	0.0	0.0	0.7

Table 1. (Continued).

	STATIONS																		
	3.9	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.1	5.2	5.3	5.4	5.5	5.6	5.7	6.1	6.2
STRATE / *STRATUM*	1	1	1	2	2	2	2	3	2	1	2	2	3	3	3	2	1	2	2
LONGITUDE	-61.75	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.75	-62.75	-62.75	-62.75	-62.75	-62.75	-62.75	-63.25	-63.25
LATITUDE	48.33	45.83	46.17	46.57	45.83	47.17	47.50	47.83	48.17	48.33	46.50	46.83	47.17	47.50	47.83	48.17	48.33	46.50	46.83
1979	---	22.3	16.9	132.0	130.7	188.1	938.7	1239.3	43.3	---	136.1	133.8	160.0	526.6	214.9	27.3	2.8	188.7	291.7
1983	0.3	119.9	29.9	92.4	6.8	41.5	635.6	585.3	632.7	17.7	56.1	16.7	153.6	508.2	1493.2	74.6	24.3	10.3	133.2
1984	0.0	165.8	173.6	74.8	353.0	113.2	204.4	154.6	0.0	0.4	44.0	92.5	1850.2	1224.6	1129.7	569.9	36.6	69.9	127.2
1985	5.4	64.3	149.9	74.7	257.5	863.6	244.9	384.4	901.9	4.7	230.5	504.4	339.4	699.7	439.8	891.3	231.6	28.9	212.6
1986	0.0	264.4	---	505.8	453.0	404.2	689.0	1988.1	70.3	0.0	1418.8	438.5	388.4	1159.4	2645.8	418.9	618.9	182.0	578.6
1987	3.8	146.5	20.9	322.2	142.6	29.6	165.8	381.5	15.4	15.9	1.0	154.6	781.7	793.1	1928.3	239.1	46.4	3.7	205.6
1988	0.0	---	---	407.6	---	1106.7	559.5	215.1	0.0	0.0	1385.3	1119.0	449.1	766.3	286.2	0.5	0.6	50.0	706.4
1989	0.0	237.8	19.6	59.8	34.8	228.0	1418.2	5.5	6.0	0.0	16.1	38.9	203.7	1796.5	186.9	0.0	1.1	66.0	60.6
1990	0.0	64.3	25.7	141.6	25.9	57.4	3.9	255.1	0.0	0.0	177.9	249.1	114.0	611.3	344.8	0.2	0.0	6.5	179.4
1991	0.0	106.5	299.6	595.6	23.3	24.3	329.2	1697.4	542.2	0.0	53.2	508.4	397.7	486.0	2579.5	42.5	6.9	189.1	305.5
1992	0.0	2.3	7.6	664.9	149.7	187.3	277.5	88.9	22.7	0.0	1.1	189.6	288.9	174.1	363.9	1569.5	133.8	0.0	119.4
1993	0.0	16.6	9.7	127.5	10.4	6.7	610.1	0.0	0.0	0.0	18.9	152.1	238.6	66.7	149.2	358.4	6.4	178.9	234.2
1994	0.0	7.7	18.9	77.1	9.1	2.5	0.0	0.0	0.0	0.0	75.1	138.3	3.9	1.4	321.4	0.0	0.0	129.8	937.3
1996	0.0	0.8	9.0	47.6	48.4	180.7	6.7	1.1	0.0	0.0	3.1	100.0	402.6	268.3	108.8	0.0	0.0	1.3	82.0
1998	0.0	0.8	51.0	1.5	67.7	351.5	161.5	14.7	0.0	0.0	0.6	37.8	253.1	99.0	248.5	0.6	0.0	2.8	37.8
2000	0.0	3.7	9.5	40.7	0.0	2.4	0.2	0.0	0.0	0.0	23.6	28.9	334.8	0.0	0.0	0.0	0.0	24.5	74.9
2002	0.0	28.9	38.7	89.0	36.0	50.1	18.9	0.2	0.0	0.0	19.2	275.6	952.9	895.6	28.1	---	0.0	3.2	355.6
2003	0.0	6.8	1077.3	413.7	205.2	1.4	0.0	0.0	0.0	0.0	209.5	456.8	36.9	0.0	0.0	0.0	0.0	677.6	601.2
2004	0.0	97.7	152.2	806.2	4.3	0.3	0.0	0.0	0.2	0.0	1067.1	117.3	15.2	119.2	391.6	0.0	0.0	1009.4	928.9
2005	0.0	1.0	219.4	16.0	60.6	10.8	38.5	0.5	0.0	0.0	11.1	208.8	13.5	0.1	0.0	0.2	0.0	18.3	828.9
2006	0.0	0.4	0.0	0.0	0.3	14.0	11.3	0.0	2.1	0.0	2.0	0.0	3.6	4.0	6.3	5.6	0.0	0.5	0.5
2007	0.0	0.0	2.9	95.0	1.1	0.7	20.7	0.0	35.9	0.0	2.5	135.1	34.0	479.5	465.4	26.5	0.0	108.9	54.9
2008	---	0.5	1.2	2.7	10.3	0.4	107.5	276.1	35.0	---	12.4	49.3	285.5	112.0	---	48.6	---	12.3	14.7
2009	0.5	0.3	4.7	16.3	5.6	13.3	0.3	64.2	1.4	0.6	2.6	28.4	9.0	71.4	61.7	39.3	0.8	2.6	5.2
2010	0.0	1.6	15.3	29.8	3.3	0.5	121.3	0.0	0.0	0.0	30.7	8.7	8.0	2.6	98.1	1.0	0.0	13.1	11.0
2011	0.0	2.6	2.4	57.7	1.2	1.6	2.2	0.0	0.0	0.0	2.6	8.1	3.2	1.5	0.9	0.4	0.0	56.9	15.4

Table 1. (Continued).

	STATIONS																		
	6.3	**6.4**	**6.5**	**6.6**	**6.7**	**7.1**	**7.2**	**7.3**	**7.4**	**7.5**	**7.6**	**7.7**	**8.1**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**
STRATE / *STRATUM*	2	3	3	3	2	2	3	3	3	2	2	1	1	2	3	3	3	2	1
LONGITUDE	-63.25	-63.25	-63.25	-63.25	-63.25	-63.75	-63.75	-63.75	-63.75	-63.75	-63.75	-63.75	-64.37	-64.25	-64.25	-64.25	-64.25	-64.08	-64.08
LATITUDE	47.17	47.50	47.83	48.17	48.50	46.83	47.17	47.50	47.83	48.17	48.50	48.83	46.83	47.17	47.50	47.83	48.17	48.50	48.75
1979	333.8	143.7	87.7	17.2	9.4	418.4	400.0	326.5	36.0	18.0	12.9	---	---	637.4	617.1	314.3	42.3	34.3	---
1983	132.6	125.0	488.0	163.6	20.3	66.3	14.9	142.5	141.7	118.1	36.7	87.2	10.3	112.7	102.2	61.6	18.2	29.7	18.3
1984	519.3	935.1	959.5	511.6	4.9	89.7	82.4	244.3	446.3	632.7	676.5	160.7	23.1	41.3	433.7	705.8	827.4	331.9	75.8
1985	228.0	1275.4	534.3	1556.3	86.8	709.2	685.4	1243.0	1545.1	773.5	404.2	33.6	70.3	---	716.1	958.1	372.6	83.8	308.3
1986	572.1	1040.5	1726.2	2262.0	677.6	2834.6	1896.4	477.0	364.0	1972.2	1508.7	20.4	147.5	716.3	1416.9	2714.4	910.4	924.9	133.7
1987	126.4	584.5	898.6	642.4	342.7	27.1	226.3	673.6	1357.2	583.1	0.8	5.5	2.8	213.4	414.7	4558.1	207.0	272.8	31.2
1988	1044.6	555.4	2233.0	96.1	1.2	209.6	803.8	1726.3	351.4	610.5	297.2	0.4	14.7	1442.9	1121.6	1414.4	3176.1	1609.9	147.2
1989	124.0	561.4	29.6	65.2	54.6	49.1	208.9	673.6	661.3	1342.5	217.2	3.9	0.0	121.9	754.6	528.4	212.5	23.6	9.2
1990	153.7	551.7	323.4	694.4	1.0	178.3	1231.5	404.5	647.8	157.1	2.9	13.2	2.4	524.8	501.7	1821.9	814.3	94.2	19.5
1991	103.1	2684.3	2348.0	8.9	0.0	407.4	559.5	249.5	540.1	515.3	0.0	2.1	16.7	377.6	1158.3	596.8	2284.5	94.1	431.1
1992	147.7	453.6	2168.3	1271.1	0.0	239.0	151.9	1045.7	232.5	1315.0	40.1	0.0	2.1	91.6	431.6	2183.6	1194.2	24.9	115.1
1993	605.3	1261.6	2002.5	545.3	47.1	820.6	2101.0	1208.8	344.6	159.0	2.6	---	157.0	2822.2	2945.7	217.7	659.9	39.3	---
1994	96.3	2004.5	170.8	83.0	0.0	810.0	297.8	2450.5	298.6	456.3	10.8	0.5	72.7	723.1	637.4	421.1	184.7	256.6	5.1
1996	422.7	114.8	27.8	0.5	0.0	88.7	31.0	38.7	79.8	154.1	---	0.0	1.5	11.5	397.8	54.7	247.5	35.6	0.9
1998	89.9	99.2	99.3	16.2	22.5	34.5	125.5	11.6	186.2	26.4	0.0	0.0	2.6	55.3	66.1	62.2	76.5	0.3	0.0
2000	37.9	47.3	201.3	0.0	0.6	381.2	79.9	137.5	2093.4	23.1	0.0	0.0	0.7	45.3	40.2	79.3	150.1	0.8	0.0
2002	765.4	600.0	32.7	0.0	0.0	522.7	659.0	425.6	2100.3	112.7	1.4	0.0	27.2	207.2	250.0	173.1	774.5	0.0	0.0
2003	896.4	115.0	0.0	0.0	0.0	674.7	1785.6	1413.2	3.3	0.2	0.0	0.0	95.0	508.1	676.5	581.2	195.5	0.0	0.0
2004	300.2	0.0	130.1	2.2	0.2	1436.4	535.3	2.5	0.0	0.0	0.0	0.1	---	341.3	13.6	125.9	8.4	0.0	0.2
2005	638.9	0.4	0.0	0.2	0.0	1205.2	433.9	36.8	12.3	0.0	0.2	---	24.1	26.0	711.0	126.2	8.7	0.1	0.0
2006	0.6	80.3	72.9	15.3	25.6	0.1	2.1	4.4	9.5	15.2	3.5	4.6	0.7	23.9	153.8	14.5	10.1	21.4	7.9
2007	100.3	35.1	420.4	262.8	14.7	45.9	71.1	232.2	57.3	30.2	61.0	8.2	0.0	54.9	179.7	184.5	211.4	246.8	97.6
2008	199.9	93.7	---	513.8	---	45.7	113.4	397.2	---	86.9	11.9	0.4	5.9	85.1	314.8	723.4	109.7	7.8	4.1
2009	66.4	136.8	5.7	6.7	0.0	17.5	45.8	204.8	112.8	19.8	438.2	0.7	39.3	40.2	94.9	779.1	84.3	---	---
2010	0.7	0.0	0.0	0.0	0.0	29.6	8.5	90.2	2.2	5.9	0.2	0.0	58.6	39.0	66.3	1.7	0.4	127.3	3.2
2011	16.3	0.8	0.7	4.1	0.3	47.1	5.6	1.7	85.3	25.7	28.2	19.7	1.9	135.4	209.2	53.8	6.9	42.3	37.2

Table 1. (Continued).

	STATIONS								STATISTIQUES / *STATISTICS*					
	9.1	9.2	9.3	9.4	9.5	10.1	11.1	12.1						
STRATE / *STRATUM*	1	1	2	2	3	2	3	3	Moyenne /	É.-T. /	Min.	Max.	Etendue /	n
LONGITUDE	-64.67	-64.75	-64.67	-64.75	-64.75	-65.25	-65.75	-66.13	*Mean*	*STD*			*Range*	
LATITUDE	46.83	47.17	47.50	47.93	48.17	47.93	48.00	48.05						
1979	---	13.3	344.5	151.5	172.7	193.3	604.7	1736.0	207.3	313.3	0.0	1736.0	1736.0	59
1983	76.6	22.7	49.2	25.7	40.4	8.5	111.8	1.2	120.4	228.2	0.3	1493.2	1492.9	64
1984	161.6	144.7	292.4	780.9	128.6	923.5	334.3	241.1	276.2	369.8	0.0	1850.2	1850.2	65
1985	11.7	6.3	522.0	684.3	1458.0	676.7	1261.6	493.2	388.2	425.6	0.0	1556.3	1556.3	64
1986	196.6	237.4	1105.0	771.4	1041.1	425.8	622.9	1181.9	765.4	737.0	0.0	2834.6	2834.6	58
1987	39.9	17.9	151.1	1120.1	1154.3	182.9	1175.7	632.6	364.4	652.3	0.8	4558.1	4557.3	65
1988	20.4	574.6	433.5	972.0	1261.5	159.0	858.4	25.2	495.4	633.0	0.0	3176.1	3176.1	62
1989	0.0	48.7	648.5	53.3	451.4	221.9	1054.8	4.6	201.9	368.0	0.0	1796.5	1796.5	65
1990	128.6	355.7	722.5	35.2	2411.7	683.1	1069.6	160.3	253.5	438.5	0.0	2411.7	2411.7	65
1991	248.3	695.2	1089.5	222.0	1990.8	95.0	866.1	54.3	420.2	663.6	0.0	2684.3	2684.3	64
1992	21.3	74.7	441.1	331.3	1834.5	1537.5	1314.7	77.8	331.1	558.6	0.0	2183.6	2183.6	65
1993	692.8	669.6	1399.4	362.6	950.1	212.1	395.3	236.1	373.9	650.6	0.0	2945.7	2945.7	63
1994	307.7	114.1	128.6	24.8	366.6	160.3	176.9	539.6	194.8	423.9	0.0	2450.5	2450.5	65
1996	2.1	0.9	49.5	1.3	132.2	98.3	52.8	1.9	58.2	97.2	0.0	422.7	422.7	64
1998	1.8	2.2	199.2	1.5	38.2	1.3	119.0	21.8	49.5	73.2	0.0	351.5	351.5	64
2000	82.7	12.4	153.2	21.0	50.9	30.8	100.4	1.4	69.0	267.1	0.0	2093.4	2093.4	64
2002	32.1	245.5	352.7	0.0	50.2	8.3	37.8	1.4	165.8	342.5	0.0	2100.3	2100.3	64
2003	225.8	140.1	593.2	134.1	10.6	7.6	375.8	23.2	197.7	356.6	0.0	1785.6	1785.6	65
2004	1215.7	539.1	1117.4	68.7	0.8	2.0	214.1	4.7	172.4	348.8	0.0	1436.4	1436.4	64
2005	254.3	429.8	765.9	0.4	0.0	1.8	15.0	---	106.7	242.3	0.0	1205.2	1205.2	61
2006	20.7	11.3	17.8	13.1	2.6	11.4	9.6	---	9.8	23.1	0.0	153.8	153.8	64
2007	1.4	6.5	38.2	22.6	1165.3	550.2	35.9	2.1	88.1	184.1	0.0	1165.3	1165.3	65
2008	87.2	75.1	151.5	0.5	785.1	113.3	63.3	---	95.3	170.8	0.0	785.1	785.1	53
2009	83.1	74.7	407.7	75.3	13.0	49.2	22.4	2.1	56.1	128.8	0.0	779.1	779.1	63
2010	1.0	79.4	71.2	2.4	265.3	10.4	62.4	2.5	20.0	43.6	0.0	265.3	265.3	65
2011	1.5	197.2	775.8	1.3	31.4	24.3	25.0	2.6	30.0	102.4	0.0	775.8	775.8	65

Table 2. Mean temperature (°C) of the first 10 meters of water for the stations of the egg surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.

	STATIONS																		
	1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.7**	**3.8**
STRATE / *STRATUM*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1
LONGITUDE	-60.92	-60.75	-60.75	-60.75	-60.75	-61.25	-61.25	-61.25	-61.25	-61.25	-61.25	-61.77	-61.75	-61.75	-61.75	-61.75	-61.83	-61.75	-61.75
LATITUDE	46.83	47.17	47.50	47.83	48.17	46.50	46.83	47.17	47.50	47.83	48.17	45.83	46.17	46.50	46.83	47.17	47.58	47.83	48.17
1979	12.4	11.5	10.2	9.0	8.8	12.2	12.2	10.2	10.9	9.8	9.6	11.5	12.7	11.8	11.5	9.8	10.9	10.6	10.6
1983	16.8	14.2	12.5	11.6	11.0	15.1	14.8	13.8	12.6	13.0	12.4	15.8	15.2	16.0	16.3	14.4	14.3	---	13.1
1984	10.4	11.0	7.8	7.5	7.0	10.5	10.5	13.0	11.6	8.0	6.5	12.0	12.0	11.9	10.7	9.0	8.3	7.4	10.3
1985	9.8	9.7	6.1	7.9	8.0	13.0	9.6	10.3	8.1	6.6	8.3	12.3	12.4	11.3	11.9	9.1	10.0	10.1	10.7
1986	---	---	---	9.0	9.0	---	---	---	10.5	9.0	9.0	---	13.5	12.0	12.0	10.5	9.5	10.0	9.0
1987	11.7	11.0	11.3	11.2	10.7	11.9	11.6	12.4	11.8	13.2	11.6	12.4	12.0	12.3	11.1	11.5	10.1	10.3	9.7
1988	10.7	8.7	7.3	6.9	6.4	11.1	9.0	8.2	7.8	6.1	6.8	12.8	10.4	10.8	9.3	9.0	8.7	8.1	7.0
1989	10.9	10.9	10.3	8.7	8.3	11.8	11.0	11.5	10.5	7.3	8.8	13.6	12.9	11.7	12.2	11.3	10.9	9.4	9.6
1990	11.0	9.0	7.2	7.1	6.9	11.0	9.9	9.7	7.6	8.5	8.5	12.9	12.5	10.8	10.3	9.8	8.6	8.7	8.2
1991	10.1	8.3	7.7	6.7	6.7	10.5	7.8	8.0	8.2	---	6.3	10.7	10.6	9.1	7.6	9.3	9.1	9.3	5.5
1992	11.8	8.0	8.7	8.3	7.4	12.2	10.4	9.3	8.4	7.6	8.2	12.6	11.8	11.2	10.8	10.5	10.3	9.6	8.7
1993	10.7	8.3	7.1	5.8	5.8	11.3	9.2	7.5	6.8	5.1	5.6	12.5	10.3	11.3	9.8	8.9	8.9	7.4	8.7
1994	10.2	6.9	6.0	5.6	5.4	8.5	6.7	6.5	7.4	6.3	5.3	11.0	8.6	9.3	7.1	5.9	7.3	5.9	5.5
1996	12.9	11.0	8.3	7.9	7.4	12.7	11.5	9.7	9.9	9.1	9.3	13.2	12.4	12.2	10.5	10.6	11.3	10.8	9.4
1998	11.7	10.2	9.2	8.5	7.8	10.8	10.1	10.5	8.4	8.3	9.1	11.2	11.1	10.7	11.5	11.0	11.2	10.6	9.1
2000	10.9	7.7	7.3	7.4	7.6	11.6	10.1	8.9	8.0	7.9	7.9	12.8	12.3	11.1	9.8	10.1	10.5	10.1	7.8
2002	9.2	8.5	6.5	6.6	6.0	10.7	9.9	8.6	8.0	6.6	6.9	11.4	11.0	10.6	10.5	8.2	7.2	7.3	7.4
2003	10.4	8.0	7.0	5.8	7.1	9.9	9.3	7.3	7.7	7.0	6.8	11.0	11.2	9.7	9.5	7.4	8.2	7.8	6.9
2004	9.2	7.1	7.0	7.0	6.7	9.6	6.7	7.7	7.0	7.0	6.6	11.1	9.8	9.1	7.9	7.6	8.4	7.5	6.6
2005	9.7	7.5	7.7	---	---	10.2	8.6	7.5	7.3	6.9	7.7	10.4	9.7	9.8	9.2	7.3	8.7	8.5	7.7
2006	15.7	13.2	13.1	12.3	12.1	15.6	---	14.1	14.9	14.1	12.9	15.9	15.0	15.8	15.1	14.8	15.3	14.5	14.5
2007	12.6	12.4	9.9	9.6	11.1	13.4	13.1	10.3	9.8	9.0	10.4	13.3	12.1	13.2	10.8	12.5	11.0	9.5	12.4
2008	14.3	---	---	---	---	15.3	13.2	11.2	9.5	9.7	10.8	14.7	14.4	14.3	12.9	11.3	11.4	11.8	10.3
2009	11.5	10.0	9.4	8.9	9.4	12.1	9.7	9.7	9.5	10.0	8.9	12.4	12.1	10.5	11.8	10.4	11.5	11.5	11.2
2010	10.8	8.6	6.3	7.1	6.6	10.7	9.9	7.9	7.0	7.9	7.2	12.4	11.1	10.6	8.6	7.7	8.5	8.2	6.9
2011	---	6.0	7.7	8.2	8.0	9.9	9.3	8.0	7.8	6.1	8.6	10.4	10.2	9.1	8.5	8.4	8.2	9.0	10.1

Table 2. (Continued).

	STATIONS																		
	3.9	**4.1**	**4.2**	**4.3**	**4.4**	**4.5**	**4.6**	**4.7**	**4.8**	**4.9**	**5.1**	**5.2**	**5.3**	**5.4**	**5.5**	**5.6**	**5.7**	**6.1**	**6.2**
STRATE / *STRATUM*	1	1	1	2	2	2	2	3	2	1	2	2	3	3	3	2	1	2	2
LONGITUDE	-61.75	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.75	-62.75	-62.75	-62.75	-62.75	-62.75	-62.75	-63.25	-63.25
LATITUDE	48.33	45.83	46.17	46.57	46.83	47.17	47.50	47.83	48.17	48.33	46.50	46.83	47.17	47.50	47.83	48.17	48.33	46.50	46.83
1979	---	11.9	11.9	13.5	13.0	11.4	12.0	12.4	11.4	---	14.1	13.2	12.1	11.9	12.2	11.4	10.6	14.0	15.0
1983	11.1	17.3	16.3	15.8	16.6	14.6	14.6	14.2	15.4	12.8	15.5	15.9	15.0	15.2	13.4	11.0	11.4	15.3	14.1
1984	10.3	12.2	11.7	11.6	9.9	9.0	8.2	6.3	9.0	9.6	13.0	11.0	10.5	9.5	9.0	11.0	10.3	12.5	11.9
1985	10.8	12.7	10.8	12.9	11.5	10.5	9.5	10.2	11.0	11.6	12.6	10.9	10.3	10.4	11.5	12.7	12.0	11.5	10.1
1986	9.0	13.5	---	13.0	12.0	11.0	11.0	11.0	9.0	9.0	13.0	12.0	12.5	11.0	11.0	11.0	11.0	12.5	12.5
1987	9.4	12.1	12.4	13.1	12.8	8.6	10.7	10.8	10.0	9.7	13.4	13.3	11.8	11.8	11.6	9.8	9.2	13.1	13.1
1988	7.0	12.1	9.8	11.5	9.9	9.4	9.2	8.7	7.5	7.3	12.1	10.9	9.5	8.8	9.3	7.4	7.9	12.4	10.7
1989	9.5	11.7	11.5	13.7	9.9	11.6	10.4	9.9	9.5	9.9	13.3	12.6	12.5	12.4	10.3	10.3	9.1	13.6	14.3
1990	8.8	12.2	11.4	12.3	10.3	9.0	8.6	9.6	8.7	9.0	12.8	11.0	9.4	10.6	9.5	9.5	8.3	10.9	11.1
1991	6.0	11.9	10.7	12.3	8.2	8.1	8.1	10.3	8.6	5.4	12.1	9.5	9.5	9.8	11.3	7.6	5.8	11.6	9.8
1992	7.3	9.7	11.8	13.7	13.1	10.7	11.0	9.3	8.6	8.4	13.7	12.4	11.5	12.1	9.9	11.1	10.5	13.0	12.8
1993	7.1	11.4	10.2	10.9	10.0	9.5	9.8	9.1	8.6	7.9	12.5	10.3	10.0	8.2	9.1	8.1	9.0	12.4	11.6
1994	5.2	10.6	9.1	10.0	8.4	7.7	6.9	6.8	7.0	7.2	10.8	9.8	8.1	7.9	9.2	9.8	9.1	11.1	9.8
1996	9.4	11.9	12.5	13.4	11.0	10.4	10.8	11.1	9.2	8.1	14.8	12.1	11.0	11.4	11.4	11.0	10.7	14.9	12.5
1998	8.8	11.0	11.0	10.4	12.3	12.3	11.8	10.8	10.4	9.8	9.0	11.9	12.1	11.2	11.8	11.1	10.4	9.8	10.1
2000	8.6	13.9	12.8	12.5	11.0	10.9	11.3	9.9	8.7	8.0	13.0	11.3	12.6	11.3	11.1	10.0	9.3	13.5	12.5
2002	6.6	10.4	10.2	11.2	10.2	9.2	8.6	8.2	7.7	6.3	10.5	11.6	9.5	9.1	8.7	---	6.9	11.3	11.8
2003	6.3	10.4	10.9	10.6	9.1	8.1	8.1	7.9	7.7	7.6	11.4	11.1	8.1	8.6	9.2	9.1	6.9	11.9	12.7
2004	6.6	9.2	9.7	10.0	8.8	7.0	8.1	8.2	7.4	7.0	10.1	9.4	8.6	9.1	8.5	7.9	7.9	9.9	9.5
2005	8.0	7.7	10.1	7.0	10.0	7.5	8.3	8.3	8.5	8.8	6.3	9.5	7.9	6.7	8.3	8.9	9.3	6.4	9.7
2006	14.3	14.9	15.5	16.4	15.7	13.1	13.1	14.1	14.9	14.7	16.7	14.9	13.4	14.2	13.0	13.7	14.8	15.7	15.0
2007	10.0	12.3	12.4	12.2	10.2	9.6	9.1	11.2	11.6	11.2	13.2	10.7	10.7	11.2	12.1	11.0	11.1	13.7	11.3
2008	---	13.9	14.1	14.6	12.0	8.9	11.9	12.1	11.4	---	14.6	12.8	12.9	12.2	---	11.9	---	15.2	13.7
2009	11.5	12.2	12.7	11.4	11.6	9.0	9.1	11.1	10.8	9.6	11.4	10.5	9.7	9.4	11.4	9.9	10.7	11.3	11.6
2010	7.3	11.8	11.8	11.3	9.7	7.8	9.4	7.0	7.2	7.7	11.5	10.3	8.9	9.1	9.2	7.2	8.0	10.3	9.2
2011	9.1	10.3	9.3	11.0	8.4	8.5	8.2	9.7	10.2	7.5	10.7	9.2	9.1	9.4	10.5	9.8	10.4	11.0	9.7

Table 2. (Continued).

	STATIONS																		
	6.3	**6.4**	**6.5**	**6.6**	**6.7**	**7.1**	**7.2**	**7.3**	**7.4**	**7.5**	**7.6**	**7.7**	**8.1**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**
STRATE / *STRATUM*	2	3	3	3	2	2	3	3	3	2	2	1	1	2	3	3	3	2	1
LONGITUDE	-63.25	-63.25	-63.25	-63.25	-63.25	-63.75	-63.75	-63.75	-63.75	-63.75	-63.75	-63.75	-64.37	-64.25	-64.25	-64.25	-64.25	-64.08	-64.08
LATITUDE	47.17	47.50	47.83	48.17	48.50	46.83	47.17	47.50	47.83	48.17	48.50	48.83	46.83	47.17	47.50	47.83	48.17	48.50	48.75
1979	13.2	15.0	12.2	10.5	10.5	15.0	13.9	15.2	13.4	10.7	11.1	---	---	14.7	12.0	11.9	9.6	10.5	---
1983	14.0	15.0	12.5	13.0	11.2	13.8	14.4	13.1	12.0	12.3	11.5	12.3	15.1	13.7	13.2	12.4	13.4	11.6	13.8
1984	12.0	10.1	9.0	10.2	10.8	12.8	12.3	11.2	11.7	11.1	11.9	10.5	13.2	13.6	11.0	11.5	12.9	11.2	11.5
1985	10.6	11.9	11.5	11.7	12.5	12.6	12.3	12.0	11.2	11.8	14.7	9.9	13.3	---	11.6	10.9	10.7	12.1	10.3
1986	12.0	12.0	12.0	11.0	10.0	13.5	12.5	12.5	12.0	11.5	8.5	9.0	14.0	13.0	13.0	13.0	11.0	11.0	9.0
1987	12.3	12.5	12.4	10.3	10.2	12.9	12.6	12.5	11.6	10.6	9.6	9.0	12.1	13.1	11.8	11.7	9.9	9.9	9.2
1988	10.6	10.1	9.7	8.0	7.9	11.1	11.9	9.9	12.5	7.6	8.7	7.8	12.9	11.4	12.2	10.9	10.5	9.4	8.7
1989	12.9	11.3	11.7	10.1	10.2	14.0	13.9	12.8	10.8	12.3	8.5	9.4	12.7	14.0	12.7	13.3	12.3	7.3	9.8
1990	10.3	10.3	9.1	9.6	8.6	13.0	12.2	10.8	10.2	8.0	9.1	7.5	12.1	12.4	10.7	9.2	9.1	9.2	9.5
1991	9.7	10.4	11.1	7.8	5.7	---	11.0	11.2	10.8	10.9	6.4	7.4	13.4	12.3	11.4	11.1	12.2	11.9	13.0
1992	12.4	11.7	11.5	9.8	7.4	12.8	13.5	13.3	13.3	12.2	9.9	9.4	14.3	13.8	13.5	12.0	13.0	9.5	10.2
1993	10.7	8.9	10.9	10.3	9.0	12.5	10.6	11.2	10.0	10.5	8.0	---	13.5	12.1	10.5	9.8	9.4	9.0	---
1994	9.7	9.6	9.3	10.2	10.3	10.9	10.6	10.7	9.7	10.2	9.7	9.5	10.6	11.0	10.3	9.8	10.7	12.0	11.4
1996	13.1	11.5	11.3	10.4	10.7	14.0	13.3	11.8	11.8	11.2	10.4	8.7	12.6	13.4	13.4	11.6	10.8	10.1	10.5
1998	11.7	11.8	11.6	10.5	11.4	11.2	11.8	11.6	11.8	10.5	10.5	9.5	12.3	11.0	10.9	10.3	10.8	8.3	6.8
2000	12.2	11.1	11.0	10.5	10.1	11.7	11.9	11.4	11.8	11.0	10.2	10.9	13.2	12.7	11.8	13.7	12.6	10.9	10.7
2002	9.6	9.7	8.9	7.7	7.7	12.1	10.8	11.5	11.2	10.2	8.4	6.5	12.3	11.0	11.5	10.8	10.2	7.8	8.2
2003	8.8	10.1	8.8	9.8	8.7	12.1	12.0	12.1	11.4	10.9	8.8	7.8	13.0	12.5	11.6	11.3	11.0	8.1	9.0
2004	8.9	8.5	9.0	8.6	7.6	10.1	9.3	9.2	7.8	7.4	7.6	8.5	---	9.7	9.0	8.6	8.3	7.6	7.5
2005	9.8	7.6	8.3	8.6	9.1	10.1	9.2	7.7	9.3	9.3	9.8	---	10.7	9.0	9.5	9.2	10.1	7.6	8.7
2006	15.2	14.6	12.4	13.5	13.3	14.9	15.2	15.1	14.3	12.4	14.7	14.1	14.8	13.5	14.8	12.4	9.6	14.0	12.6
2007	10.7	10.4	11.5	11.7	11.5	12.2	12.1	11.3	13.1	11.4	11.7	12.3	14.2	13.3	11.7	10.7	11.0	11.7	10.3
2008	13.3	11.8	---	12.4	---	13.2	14.4	12.6	---	11.6	11.2	11.0	15.6	15.1	11.1	11.5	10.6	10.9	10.5
2009	10.3	12.2	12.2	10.1	10.0	12.4	11.9	11.0	11.8	11.4	11.8	8.8	12.4	11.6	10.1	10.2	9.4	---	---
2010	8.2	9.5	7.1	8.3	7.9	11.2	10.6	10.5	9.8	7.5	7.6	7.9	11.7	11.2	10.2	9.7	8.5	10.7	9.7
2011	9.1	9.0	10.4	9.8	9.7	9.7	9.4	8.8	11.3	9.2	9.7	7.3	10.4	11.4	11.1	9.6	8.8	9.4	7.9

Table 2. (Continued).

	STATIONS								STATISTIQUES / *STATISTICS*					
	9.1	9.2	9.3	9.4	9.5	10.1	11.1	12.1						
STRATE / *STRATUM*	1	1	2	2	3	2	3	3	Moyenne / *Mean*	É.-T. / *STD*	Min.	Max.	Étendue / *Range*	n
LONGITUDE	-64.67	-64.75	-64.67	-64.75	-64.75	-65.25	-65.75	-66.13						
LATITUDE	46.83	47.17	47.50	47.93	48.17	47.93	48.00	48.05						
1979	---	12.6	12.2	12.7	12.5	11.9	12.5	14.2	12.0	1.5	8.8	15.2	6.4	59
1983	16.2	14.3	14.2	15.6	14.6	15.0	14.3	13.9	14.0	1.6	11.0	17.3	6.3	64
1984	13.0	12.0	12.0	13.3	13.0	13.7	12.0	13.3	10.8	1.8	6.3	13.7	7.4	65
1985	12.1	11.9	12.3	11.9	11.6	12.8	12.4	13.8	11.1	1.6	6.1	14.7	8.6	64
1986	14.5	14.5	14.0	12.0	13.0	12.0	14.0	14.0	11.5	1.7	8.5	14.5	6.0	57
1987	14.1	13.4	12.0	12.0	10.3	11.1	11.4	11.5	11.5	1.3	8.6	14.1	5.5	65
1988	12.1	12.3	10.6	13.6	10.7	10.6	11.7	10.5	9.7	1.9	6.1	13.6	7.5	65
1989	15.6	12.9	11.7	15.0	12.4	11.4	11.3	10.2	11.3	1.8	7.3	15.6	8.3	65
1990	11.8	11.7	10.9	7.3	8.2	11.2	13.1	12.8	10.0	1.6	6.9	13.1	6.2	65
1991	15.1	13.8	12.5	15.9	12.3	9.5	12.5	12.1	9.8	2.4	5.4	15.9	10.5	63
1992	14.0	14.6	12.5	13.1	11.9	13.5	12.9	13.3	11.2	2.0	7.3	14.6	7.3	65
1993	13.5	11.1	10.5	12.7	9.3	9.2	12.4	10.7	9.7	1.9	5.1	13.5	8.4	63
1994	11.9	11.7	12.1	10.3	10.1	11.2	10.5	10.6	9.0	2.0	5.2	12.1	6.9	65
1996	13.9	14.2	12.5	8.9	9.4	9.7	10.5	10.4	11.2	1.7	7.4	14.9	7.5	65
1998	12.4	10.9	11.1	9.1	12.0	9.0	12.4	12.0	10.6	1.3	6.8	12.4	5.7	65
2000	13.8	12.9	13.5	13.1	12.6	10.0	12.2	11.5	10.9	1.8	7.3	13.9	6.7	65
2002	12.6	13.1	12.0	11.5	10.5	10.8	11.8	12.2	9.5	1.9	6.0	13.1	7.1	64
2003	12.8	12.8	12.0	14.2	11.8	10.4	14.0	10.8	9.7	2.1	5.8	14.2	8.4	65
2004	11.2	9.3	8.9	9.9	9.1	8.6	9.3	8.9	8.5	1.1	6.6	11.2	4.6	64
2005	9.6	10.3	9.2	9.4	9.5	9.9	11.9	---	8.8	1.2	6.3	11.9	5.6	61
2006	13.5	9.4	11.2	15.4	9.3	10.9	12.3	---	14.0	1.6	9.3	16.7	7.4	63
2007	14.4	14.2	13.3	13.9	11.9	12.2	14.0	14.0	11.7	1.4	9.0	14.4	5.4	65
2008	13.5	13.9	13.2	9.4	10.8	12.0	13.2	---	12.5	1.7	8.9	15.6	6.7	53
2009	12.8	13.0	11.6	9.7	9.5	10.0	10.7	10.0	10.8	1.1	8.8	13.0	4.2	63
2010	12.3	10.9	10.4	10.9	10.9	11.0	12.4	11.9	9.3	1.7	6.3	12.4	6.2	65
2011	11.9	11.5	11.3	12.4	9.7	9.3	12.3	10.2	9.5	1.3	6.0	12.4	6.4	64

Table 3. Incubation time (hr) of the Atlantic mackerel eggs for the stations of the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011 according to the Lockwood et al. model (1977).

	STATIONS																		
	1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.7**	**3.8**
STRATE / *STRATUM*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1
LONGITUDE	-60.92	-60.75	-60.75	-60.75	-60.75	-61.25	-61.25	-61.25	-61.25	-61.25	-61.25	-61.77	-61.75	-61.75	-61.75	-61.75	-61.83	-61.75	-61.75
LATITUDE	46.83	47.17	47.50	47.83	48.17	46.50	46.83	47.17	47.50	47.83	48.17	45.83	46.17	46.50	46.83	47.17	47.58	47.83	48.17
1979	40.7	46.0	55.8	68.2	70.7	41.8	41.8	55.8	50.1	59.5	61.5	46.0	39.2	44.1	46.0	59.5	50.1	52.4	52.4
1983	25.0	32.7	40.2	45.3	49.4	29.6	30.6	34.3	39.7	37.7	40.7	27.6	29.3	27.0	26.2	32.0	32.4	---	37.3
1984	54.0	49.4	85.9	91.5	102.2	53.2	53.2	37.7	45.3	82.4	115.2	42.9	42.9	43.5	51.6	68.2	77.7	93.5	54.9
1985	59.5	60.5	127.6	84.1	82.4	37.7	61.5	54.9	80.8	112.4	77.7	41.2	40.7	47.3	43.5	67.0	57.6	56.6	51.6
1986	---	---	---	68.2	68.2	---	---	---	53.2	68.2	68.2	---	35.5	42.9	42.9	53.2	62.5	57.6	68.2
1987	44.7	49.4	47.3	48.0	51.6	43.5	45.3	40.7	44.1	36.8	45.3	40.7	42.9	41.2	48.7	46.0	56.6	54.9	60.5
1988	52.0	72.0	96.4	105.6	118.1	48.4	68.4	78.6	85.9	126.2	106.6	38.5	53.8	51.2	64.9	68.4	72.3	80.8	102.9
1989	50.0	50.5	54.7	72.0	77.8	44.4	49.7	46.1	53.1	94.9	70.8	35.2	38.2	45.0	42.1	47.3	50.5	63.3	61.2
1990	49.4	68.1	97.2	100.4	104.9	49.7	59.0	61.0	90.5	75.2	75.5	38.1	40.4	51.2	55.2	59.8	73.2	72.2	78.8
1991	57.0	78.5	88.6	109.2	108.6	53.6	86.2	83.3	79.1	---	120.2	51.3	52.1	66.6	88.8	64.2	66.8	64.2	149.8
1992	43.9	82.8	72.4	78.3	93.3	42.1	54.2	65.0	76.8	89.0	78.6	39.6	44.2	48.0	50.8	53.5	54.9	61.6	72.4
1993	51.4	77.4	100.8	138.0	138.7	47.0	65.7	92.5	106.6	170.7	147.7	40.2	54.5	47.2	59.6	68.9	69.1	94.1	71.6
1994	55.9	104.6	132.1	146.8	157.6	74.8	110.7	114.3	93.9	122.4	160.9	49.7	73.2	64.9	101.1	134.6	95.5	135.7	152.0
1996	38.3	49.4	77.1	84.3	94.5	39.1	46.0	60.4	58.1	67.5	65.3	36.9	40.7	42.0	53.5	52.8	47.0	50.6	63.4
1998	44.5	56.1	65.6	74.6	86.6	50.9	56.7	53.0	76.8	78.3	67.5	48.0	48.7	51.5	46.0	49.2	47.7	52.2	67.5
2000	50.2	87.2	96.1	93.7	89.3	45.5	57.0	69.9	83.2	84.3	84.7	38.6	41.4	48.5	59.8	56.3	52.9	56.4	85.9
2002	66.1	75.0	115.0	111.0	131.8	51.9	59.0	73.7	81.9	111.6	105.0	46.7	49.7	52.5	53.1	79.1	97.6	96.2	93.3
2003	53.8	83.3	102.7	138.0	99.0	58.1	65.0	96.2	87.7	101.7	107.9	49.5	48.2	60.7	62.5	93.1	79.5	85.2	104.4
2004	65.4	101.0	102.6	102.0	108.9	61.6	109.7	88.4	101.3	102.1	113.0	48.4	59.1	66.4	83.9	88.9	76.6	91.7	111.5
2005	60.5	91.5	87.7	---	---	55.8	74.1	91.5	95.5	104.6	87.7	54.0	60.5	59.5	65.8	95.5	72.0	74.8	87.7
2006	27.9	37.0	37.1	41.1	42.6	28.0	---	33.0	30.2	33.1	38.1	27.3	29.8	27.6	29.6	30.6	29.1	31.8	31.6
2007	39.7	40.7	58.1	61.4	48.9	35.8	37.4	54.6	59.0	68.1	54.0	36.4	42.5	37.0	50.9	40.3	49.2	62.6	40.6
2008	32.5	---	---	---	---	29.1	36.7	48.2	62.4	60.5	51.0	31.1	31.9	32.5	38.3	47.6	46.9	44.2	55.3
2009	46.2	57.3	63.8	69.6	64.0	42.5	60.2	60.6	62.5	57.9	70.1	40.9	42.5	53.6	44.2	54.3	46.3	45.8	48.0
2010	51.2	73.1	122.4	100.1	111.3	51.3	58.8	83.4	102.2	84.3	97.7	40.8	48.4	52.5	73.5	86.9	74.9	80.0	104.4
2011	---	130.7	88.4	79.5	81.9	58.9	65.1	81.9	85.3	126.6	73.1	53.8	56.0	66.6	75.1	76.5	79.5	68.4	57.0

Table 3. (Continued).

	STATIONS																		
	3.9	**4.1**	**4.2**	**4.3**	**4.4**	**4.5**	**4.6**	**4.7**	**4.8**	**4.9**	**5.1**	**5.2**	**5.3**	**5.4**	**5.5**	**5.6**	**5.7**	**6.1**	**6.2**
STRATE / *STRATUM*	1	1	1	2	2	2	2	3	2	1	2	2	3	3	3	2	1	2	2
LONGITUDE	-61.75	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.75	-62.75	-62.75	-62.75	-62.75	-62.75	-62.75	-63.25	-63.25
LATITUDE	48.33	45.83	46.17	46.57	46.83	47.17	47.50	47.83	48.17	48.33	46.50	46.83	47.17	47.50	47.83	48.17	48.33	46.50	46.83
1979	---	43.3	43.3	35.5	37.7	46.6	42.9	40.7	46.6	---	33.1	36.8	42.3	43.5	41.8	46.6	52.4	33.5	30.0
1983	48.7	23.8	26.2	27.6	25.5	31.3	31.3	32.7	28.7	38.7	28.4	27.3	30.0	29.3	35.9	49.4	46.6	29.0	33.1
1984	54.9	41.8	44.7	45.3	58.5	68.2	79.2	121.1	68.2	61.5	37.7	49.4	53.2	62.5	68.2	49.4	54.9	40.2	43.5
1985	50.9	39.2	50.9	38.2	46.0	53.2	62.5	55.8	49.4	45.3	39.7	50.1	54.9	54.0	46.0	39.2	42.9	46.0	56.6
1986	68.2	35.5	---	37.7	42.9	49.4	49.4	49.4	68.2	68.2	37.7	42.9	40.2	49.4	49.4	49.4	49.4	40.2	40.2
1987	63.6	42.3	40.7	37.3	38.7	73.4	51.6	50.9	57.6	60.5	35.9	36.4	44.1	44.1	45.3	59.5	65.8	37.3	37.3
1988	102.9	42.2	59.3	45.8	58.1	63.8	65.4	71.9	91.7	95.1	42.6	50.0	63.0	70.2	65.0	93.1	84.3	40.6	51.9
1989	62.7	44.5	46.1	34.6	58.4	45.3	54.1	59.0	62.3	58.5	36.5	39.9	40.2	40.8	54.8	55.3	66.9	35.0	32.3
1990	70.3	41.6	46.7	41.5	54.5	68.7	72.8	61.2	71.6	67.8	38.8	49.2	63.2	52.6	62.3	62.2	78.0	50.3	48.9
1991	131.4	43.4	51.5	41.3	79.9	81.1	80.3	55.1	73.9	154.8	42.6	62.5	62.7	59.5	47.3	90.3	138.0	45.3	59.1
1992	95.7	60.8	44.2	34.8	37.5	51.8	49.2	64.4	72.8	76.7	34.7	40.7	45.8	42.2	58.2	48.7	53.5	37.6	38.5
1993	99.9	46.9	55.6	50.0	57.8	62.5	59.9	66.8	73.5	84.1	40.2	55.0	57.8	79.2	67.5	80.6	68.4	40.8	45.4
1994	165.5	52.2	66.6	57.7	77.0	87.5	104.1	107.9	103.2	97.9	50.9	59.9	81.6	84.0	66.3	60.0	67.1	48.4	59.8
1996	63.3	43.4	40.0	35.9	49.7	54.2	50.7	48.4	65.9	81.5	30.6	42.2	49.3	46.8	46.4	49.2	51.6	30.3	40.4
1998	71.1	49.4	49.4	53.8	41.4	41.2	44.3	50.7	54.0	59.7	68.3	43.6	42.4	48.2	44.1	48.5	54.0	59.4	56.5
2000	73.3	33.8	38.7	40.4	49.6	49.8	47.3	58.2	72.3	82.6	37.5	47.4	39.5	47.0	48.5	57.8	64.8	35.4	40.4
2002	111.5	54.1	55.8	47.8	55.3	65.5	73.5	79.4	86.8	120.4	53.0	45.3	63.0	66.6	72.5	---	103.8	47.5	44.1
2003	122.7	54.0	50.2	52.7	67.5	81.6	80.2	84.3	86.9	88.8	46.5	49.0	80.5	73.8	66.4	67.0	104.6	43.3	39.1
2004	111.1	65.6	60.8	57.9	70.7	103.3	80.2	79.1	93.4	102.4	56.5	63.2	72.9	67.2	74.2	84.1	84.1	58.1	62.0
2005	82.4	87.7	56.6	102.2	57.6	91.5	77.7	77.7	74.8	70.7	121.1	62.5	84.1	109.7	77.7	69.4	64.7	118.1	60.5
2006	32.2	30.4	28.6	25.9	28.0	37.5	37.5	33.1	30.2	31.1	25.3	30.3	35.9	32.8	37.6	34.6	30.6	27.8	29.9
2007	57.5	41.4	40.6	42.0	56.1	61.5	67.2	47.8	45.2	48.2	36.6	51.9	51.8	48.1	42.3	49.3	48.3	34.8	47.1
2008	---	33.8	33.1	31.4	42.7	69.1	43.6	42.6	46.5	---	31.2	38.7	38.3	41.6	---	43.6	---	29.2	34.6
2009	46.2	41.8	39.4	46.6	45.5	68.8	66.9	48.4	50.6	61.1	46.5	53.0	60.5	64.0	46.4	58.1	51.3	47.4	45.5
2010	94.9	44.2	44.2	47.0	60.6	85.2	64.0	101.5	97.0	87.1	46.2	55.3	69.1	67.5	65.8	97.7	82.6	54.6	65.5
2011	66.8	54.5	65.3	49.2	76.2	74.4	78.6	60.1	55.8	92.3	52.0	65.9	66.8	63.5	53.5	59.3	53.9	49.2	60.3

Table 3. (Continued).

	STATIONS																		
	6.3	**6.4**	**6.5**	**6.6**	**6.7**	**7.1**	**7.2**	**7.3**	**7.4**	**7.5**	**7.6**	**7.7**	**8.1**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**
STRATE / *STRATUM*	2	3	3	3	2	2	3	3	3	2	2	1	1	2	3	3	3	2	1
LONGITUDE	-63.25	-63.25	-63.25	-63.25	-63.25	-63.75	-63.75	-63.75	-63.75	-63.75	-63.75	-63.75	-64.37	-64.25	-64.25	-64.25	-64.25	-64.08	-64.08
LATITUDE	47.17	47.50	47.83	48.17	48.50	46.83	47.17	47.50	47.83	48.17	48.50	48.83	46.83	47.17	47.50	47.83	48.17	48.50	48.75
1979	36.8	30.0	41.8	53.2	53.2	30.0	33.9	29.3	35.9	51.6	48.7	---	---	31.0	42.9	43.5	61.5	53.2	---
1983	33.5	30.0	40.2	37.7	48.0	34.3	32.0	37.3	42.9	41.2	46.0	41.2	29.6	34.7	36.8	40.7	35.9	45.3	34.3
1984	42.9	56.6	68.2	55.8	50.9	38.7	41.2	48.0	44.7	48.7	43.5	53.2	36.8	35.1	49.4	46.0	38.2	48.0	46.0
1985	52.4	43.5	46.0	44.7	40.2	39.7	41.2	42.9	48.0	44.1	31.0	58.5	36.4	---	45.3	50.1	51.6	42.3	54.9
1986	42.9	42.9	42.9	49.4	57.6	35.5	40.2	40.2	42.9	46.0	74.8	68.2	33.5	37.7	37.7	37.7	49.4	49.4	68.2
1987	41.2	40.2	40.7	54.9	55.8	38.2	39.7	40.2	45.3	52.4	61.5	68.2	42.3	37.3	44.1	44.7	58.5	58.5	65.8
1988	52.6	56.8	60.3	82.3	84.8	48.7	43.3	58.8	40.2	88.8	72.4	86.8	38.0	46.8	42.1	50.2	53.1	63.6	71.5
1989	38.3	47.2	44.8	57.1	55.9	33.7	34.0	38.9	50.9	41.1	74.8	63.8	39.0	33.5	39.2	36.5	41.2	96.4	59.1
1990	54.8	54.8	67.6	61.6	73.4	38.0	41.6	50.9	55.9	83.1	66.8	90.9	42.6	41.0	51.5	66.4	67.1	65.8	62.4
1991	60.1	53.7	48.7	86.2	141.1	---	49.3	48.3	51.1	49.8	118.7	94.1	35.8	41.4	46.4	48.4	41.6	43.3	37.7
1992	41.0	44.5	45.7	59.4	93.1	38.7	35.5	36.5	36.2	42.0	58.4	63.3	32.3	34.2	35.6	43.1	37.9	62.2	55.8
1993	52.0	69.7	50.3	55.2	68.1	40.2	52.1	48.0	57.5	53.1	81.9	---	35.7	42.6	53.1	60.0	63.7	68.6	---
1994	60.9	61.9	65.0	56.0	55.3	50.3	52.6	51.3	60.3	55.6	60.9	62.6	52.6	49.6	54.6	59.7	51.5	42.7	46.9
1996	37.2	45.7	47.5	54.5	52.0	33.5	36.3	44.4	44.2	47.7	54.0	72.3	39.9	36.1	36.1	45.4	50.6	56.6	53.2
1998	44.9	44.0	45.1	53.0	46.4	48.0	43.9	45.6	44.0	53.5	53.5	62.6	41.5	49.6	50.0	55.0	50.9	78.2	107.9
2000	41.7	48.6	49.1	53.3	56.8	44.8	43.3	46.7	44.2	49.1	55.6	49.9	36.8	39.2	43.8	34.8	39.6	49.8	51.7
2002	61.9	60.4	70.1	87.2	87.2	42.1	50.5	46.2	48.2	55.9	75.9	116.1	41.1	49.4	46.1	51.1	55.5	85.5	79.1
2003	71.0	56.4	70.8	59.6	71.9	42.4	43.0	42.2	46.4	50.5	70.3	85.3	38.0	40.1	45.3	47.3	49.3	81.6	68.4
2004	69.3	75.0	68.1	74.0	90.1	56.9	64.9	66.1	86.1	93.5	89.0	74.5	---	60.3	68.5	73.7	77.6	90.0	91.2
2005	59.5	89.5	77.7	73.4	67.0	56.6	65.8	87.7	64.7	64.7	59.5	---	51.6	68.2	62.5	65.8	56.6	89.5	72.0
2006	29.5	31.3	40.8	35.7	36.5	30.4	29.4	29.6	32.3	40.7	30.9	33.3	30.6	35.5	30.5	40.8	62.0	33.6	39.5
2007	51.7	54.5	46.0	44.7	46.1	41.9	42.6	47.1	37.4	46.3	44.9	41.3	32.9	36.5	44.8	51.7	49.7	44.7	55.3
2008	36.3	43.9	---	40.7	---	36.7	31.9	39.5	---	45.3	48.0	49.1	28.1	29.7	48.7	46.2	52.2	50.3	53.5
2009	55.0	42.0	42.0	56.6	57.7	40.8	43.3	49.2	44.3	46.9	44.1	71.4	40.6	45.3	56.6	55.7	64.0	---	---
2010	79.4	62.1	99.9	77.8	84.3	48.2	52.3	53.5	59.8	92.5	89.9	84.3	45.0	47.8	55.8	61.0	75.1	51.4	60.1
2011	67.4	68.0	54.4	59.2	60.4	60.3	64.1	70.8	47.5	66.1	60.9	96.0	54.5	46.8	48.9	61.6	71.1	64.0	84.6

Table 3. (Continued).

	STATIONS								STATISTIQUES / *STATISTICS*					
	9.1	9.2	9.3	9.4	9.5	10.1	11.1	12.1						
STRATE / *STRATUM*	1	1	2	2	3	2	3	3	Moyenne / *Mean*	É.-T. / *STD*	Min.	Max.	Étendue / *Range*	n
LONGITUDE	-64.67	-64.75	-64.67	-64.75	-64.75	-65.25	-65.75	-66.13						
LATITUDE	46.83	47.17	47.50	47.93	48.17	47.93	48.00	48.05						
1979	---	39.7	41.8	39.2	40.2	43.5	40.2	32.7	44.6	9.4	29.3	70.7	41.4	59
1983	26.5	32.4	32.7	28.1	31.3	30.0	32.4	33.9	34.5	6.7	23.8	49.4	25.6	64
1984	37.7	42.9	42.9	36.4	37.7	34.7	42.9	36.4	54.6	19.0	34.7	121.1	86.4	65
1985	42.3	43.5	41.2	43.5	45.3	38.7	40.7	34.3	51.7	16.7	31.0	127.6	96.6	64
1986	31.6	31.6	33.5	42.9	37.7	42.9	33.5	33.5	48.1	12.2	31.6	74.8	43.1	57
1987	33.1	35.9	42.9	42.9	54.9	48.7	46.6	46.0	47.6	9.2	33.1	73.4	40.3	65
1988	42.1	41.4	52.7	34.9	51.6	52.1	44.7	52.9	65.6	21.7	34.9	126.2	91.3	65
1989	28.1	38.3	44.6	30.1	40.6	46.9	47.5	55.5	49.7	14.1	28.1	96.4	68.3	65
1990	44.2	44.5	50.3	95.1	79.2	47.8	37.5	38.6	61.2	16.7	37.5	104.9	67.4	65
1991	29.7	34.2	40.2	27.3	41.2	62.6	40.4	42.2	68.0	30.9	27.3	154.8	127.4	63
1992	33.4	31.3	40.2	37.4	43.6	35.5	38.0	36.3	52.0	17.1	31.3	95.7	64.5	65
1993	35.7	48.7	53.2	39.1	64.7	66.1	40.5	51.3	66.4	27.2	35.7	170.7	135.1	63
1994	43.5	44.6	42.3	54.8	57.1	48.2	53.0	52.3	77.3	33.6	42.3	165.5	123.2	65
1996	33.9	32.8	40.2	69.2	64.0	60.3	53.0	53.8	50.5	13.3	30.3	94.5	64.2	65
1998	40.7	50.0	48.8	66.5	43.0	68.7	40.6	43.0	54.2	12.7	40.6	107.9	67.3	65
2000	34.2	38.0	35.6	37.3	39.6	57.6	41.7	45.7	53.1	16.5	33.8	96.1	62.3	65
2002	39.7	37.4	42.7	45.8	53.2	51.1	43.9	42.0	68.1	24.3	37.4	131.8	94.5	64
2003	38.7	38.6	43.0	32.6	43.9	53.7	33.5	51.2	66.6	23.6	32.6	138.0	105.4	65
2004	47.8	64.4	69.6	58.8	67.5	73.2	64.8	69.2	78.3	17.2	47.8	113.0	65.3	64
2005	61.5	54.9	65.8	63.6	62.5	58.5	43.5	---	73.9	16.9	43.5	121.1	77.6	61
2006	35.3	63.2	47.9	28.7	64.6	50.1	41.5	---	34.7	8.2	25.3	64.6	39.3	63
2007	32.0	32.7	36.3	33.9	43.5	41.6	33.4	33.5	45.9	8.7	32.0	68.1	36.1	65
2008	35.5	33.7	36.9	64.0	50.7	43.0	36.6	---	42.1	9.6	28.1	69.1	41.0	53
2009	38.8	37.9	45.5	60.5	63.0	58.0	52.0	57.2	52.2	9.1	37.9	71.4	33.5	63
2010	41.4	49.8	54.4	50.3	50.3	49.7	40.6	43.3	69.0	21.0	40.6	122.4	81.8	65
2011	43.4	46.2	47.5	40.7	61.0	64.5	41.1	56.2	65.8	16.9	40.7	130.7	90.0	64

Table 4. Daily egg production (developmental stages 1 and 5) (n/m^2) of the Atlantic mackerel for the stations of the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.

	STATIONS																		
	1.1	**1.2**	**1.3**	**1.4**	**1.5**	**2.1**	**2.2**	**2.3**	**2.4**	**2.5**	**2.6**	**3.1**	**3.2**	**3.3**	**3.4**	**3.5**	**3.6**	**3.7**	**3.8**
STRATE / *STRATUM*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1
LONGITUDE	-60.92	-60.75	-60.75	-60.75	-60.75	-61.25	-61.25	-61.25	-61.25	-61.25	-61.25	-61.77	-61.75	-61.75	-61.75	-61.75	-61.83	-61.75	-61.75
LATITUDE	46.83	47.17	47.50	47.83	48.17	46.50	46.83	47.17	47.50	47.83	48.17	45.83	46.17	46.50	46.83	47.17	47.58	47.83	48.17
1979	5.0	45.9	0.0	0.0	0.4	49.5	22.1	6.5	50.4	24.1	0.1	63.8	4.6	45.9	71.3	20.0	146.6	29.9	0.1
1983	2.3	3.2	36.3	12.6	0.2	30.3	2.1	21.5	52.7	84.5	4.8	66.5	47.6	69.7	11.7	123.1	45.9	---	1.8
1984	18.0	38.8	0.0	0.6	0.0	30.6	16.1	10.7	7.4	0.5	1.4	46.4	17.7	48.0	27.9	2.7	96.7	2.6	0.4
1985	3.6	11.7	0.0	0.0	0.2	47.4	7.6	45.8	2.3	0.0	0.0	37.0	57.2	89.6	103.0	82.3	54.0	79.2	140.8
1986	---	---	---	0.0	0.0	---	---	---	128.2	234.5	0.0	---	32.7	340.9	102.6	122.6	479.4	400.4	0.0
1987	21.4	76.8	20.6	0.6	1.7	95.1	130.3	125.9	66.2	148.7	15.1	61.8	117.1	216.6	86.1	101.6	62.8	40.7	37.2
1988	174.6	18.9	0.0	0.0	0.0	109.9	79.7	35.7	1.1	0.0	0.1	316.7	54.2	50.8	62.0	185.1	21.7	0.0	0.0
1989	0.2	11.4	1.2	0.0	0.0	16.8	4.8	22.8	2.0	0.3	2.5	85.1	80.8	24.9	21.6	21.8	53.6	0.9	0.0
1990	21.8	5.3	0.0	0.0	0.0	82.6	3.3	4.5	0.9	0.0	0.0	62.7	39.1	24.7	6.8	10.0	0.0	1.6	0.0
1991	25.9	1.4	0.0	0.0	0.0	49.3	4.0	0.0	0.7	---	0.0	63.1	57.6	48.6	2.4	6.2	1.6	168.3	0.0
1992	2.2	8.3	7.8	0.0	0.0	18.4	2.7	17.8	1.6	0.5	0.0	16.6	100.3	46.8	21.3	10.6	0.4	5.5	0.2
1993	40.1	7.3	0.0	0.0	0.0	30.5	4.1	2.9	0.2	0.1	0.0	110.5	22.1	10.3	6.5	13.9	2.3	0.3	0.0
1994	1.3	6.2	0.0	0.0	0.0	2.6	1.3	1.0	0.0	0.0	0.0	27.4	0.6	8.3	2.3	0.1	0.1	0.0	0.0
1996	16.0	28.8	0.1	0.0	0.0	6.0	14.3	8.1	22.5	0.0	0.0	11.9	5.6	54.6	13.6	29.2	2.6	0.5	0.0
1998	7.7	10.6	8.3	0.0	0.0	3.4	10.2	81.9	0.5	0.1	0.1	11.3	23.1	8.4	32.0	26.7	0.0	---	0.0
2000	1.3	1.0	0.0	0.0	0.0	2.9	1.9	0.0	0.0	0.0	0.0	25.4	4.7	18.4	---	0.5	0.1	0.0	0.0
2002	6.7	3.3	0.2	0.0	0.0	9.6	7.2	1.8	0.1	0.0	0.0	30.8	50.6	56.2	29.8	2.8	0.2	0.0	0.0
2003	9.1	8.6	0.1	0.0	0.0	68.8	34.0	0.0	0.0	0.0	0.0	24.1	90.0	42.1	23.2	0.3	0.0	0.0	0.0
2004	13.5	1.7	0.0	0.0	0.0	1.6	4.1	0.4	0.0	0.0	0.0	76.6	5.3	7.4	2.6	0.1	0.0	0.0	0.0
2005	36.1	6.4	0.2	---	---	6.4	3.6	21.3	1.6	0.0	0.0	0.7	5.6	15.9	12.9	17.2	0.0	0.0	0.0
2006	0.0	0.0	1.9	0.0	0.1	0.4	---	0.2	1.3	6.3	0.4	5.2	0.2	0.0	0.0	2.3	1.0	0.5	0.0
2007	1.4	0.8	2.4	0.0	0.0	1.6	0.9	0.0	0.0	0.0	0.0	45.9	0.1	13.3	5.5	4.9	0.0	0.0	0.0
2008	1.0	---	---	---	---	1.6	0.7	1.1	0.0	0.1	0.0	0.7	0.1	0.5	0.0	7.5	0.1	36.8	0.0
2009	1.5	0.9	0.0	0.0	0.0	0.0	3.6	1.1	0.3	0.0	0.0	1.9	0.7	0.7	1.6	0.3	1.2	184.5	0.7
2010	1.5	1.1	0.0	0.0	0.0	0.5	2.9	0.0	0.0	0.0	0.0	2.2	0.2	1.9	0.8	0.0	0.0	0.0	0.0
2011	---	0.0	0.0	0.0	0.0	0.2	0.0	0.3	0.0	0.0	0.0	1.0	0.3	0.8	0.6	0.1	0.0	0.0	0.3

Table 4. (Continued).

	STATIONS																		
	3.9	**4.1**	**4.2**	**4.3**	**4.4**	**4.5**	**4.6**	**4.7**	**4.8**	**4.9**	**5.1**	**5.2**	**5.3**	**5.4**	**5.5**	**5.6**	**5.7**	**6.1**	**6.2**
STRATE / *STRATUM*	1	1	1	2	2	2	2	3	2	1	2	2	3	3	3	2	1	2	2
LONGITUDE	-61.75	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.25	-62.75	-62.75	-62.75	-62.75	-62.75	-62.75	-62.75	-63.25	-63.25
LATITUDE	48.33	45.83	46.17	46.57	46.83	47.17	47.50	47.83	48.17	48.33	46.50	46.83	47.17	47.50	47.83	48.17	48.33	46.50	46.83
1979	---	12.3	9.3	89.2	83.1	96.8	524.9	730.6	22.3	---	98.7	87.2	90.7	290.5	123.4	14.0	1.3	135.3	233.6
1983	0.2	120.8	27.4	80.5	6.4	31.8	487.4	429.2	528.6	11.0	47.4	14.6	123.0	415.8	997.3	36.3	12.5	8.5	96.5
1984	0.0	95.2	93.2	39.6	144.8	39.8	61.9	30.6	0.0	0.2	28.0	45.0	834.5	470.1	397.6	277.0	16.0	41.7	70.2
1985	2.5	39.4	70.7	46.9	134.4	389.5	94.0	165.5	438.4	2.5	139.4	241.6	148.4	310.8	229.6	546.1	129.5	15.1	90.1
1986	0.0	178.7	---	321.8	253.3	196.5	334.9	966.4	24.7	0.0	902.5	245.2	231.9	563.6	1 286.1	203.6	300.8	108.7	345.5
1987	1.4	83.0	12.3	207.5	88.5	9.7	77.1	180.1	6.4	6.3	0.7	102.0	425.5	431.7	1 021.0	96.5	16.9	2.4	132.4
1988	0.0	---	---	213.4	---	416.3	205.4	71.8	0.0	0.0	779.9	537.6	171.0	262.0	105.6	0.1	0.2	29.6	326.9
1989	0.0	128.4	10.2	41.4	14.3	120.9	628.9	2.2	2.3	0.0	10.6	23.4	121.7	1 056.3	81.9	0.0	0.4	45.3	45.1
1990	0.0	37.1	13.2	81.9	11.4	20.0	1.3	100.1	0.0	0.0	110.1	121.4	43.3	279.1	132.8	0.1	0.0	3.1	88.0
1991	0.0	58.9	139.5	346.1	7.0	7.2	98.4	738.8	176.0	0.0	29.9	195.2	152.2	196.2	1 307.5	11.3	1.2	100.3	124.5
1992	0.0	0.9	4.1	458.6	95.8	86.8	135.3	33.1	7.5	0.0	0.8	111.8	151.3	98.9	150.0	773.0	60.0	0.0	74.4
1993	0.0	8.5	4.2	61.2	4.3	2.6	244.6	0.0	0.0	0.0	11.3	66.4	99.0	20.2	53.1	106.7	2.2	105.2	123.8
1994	0.0	3.6	6.8	32.1	2.8	0.7	0.0	0.0	0.0	0.0	35.4	55.5	1.1	0.4	116.4	0.0	0.0	64.4	376.4
1996	0.0	0.4	5.4	31.8	23.4	80.0	3.2	0.5	0.0	0.0	2.4	56.9	196.0	137.5	56.2	0.0	0.0	1.0	48.7
1998	0.0	0.4	24.8	0.6	39.2	204.5	87.5	7.0	0.0	0.0	0.2	20.8	143.2	49.2	135.2	0.3	0.0	1.1	16.1
2000	0.0	2.7	5.9	24.2	0.0	1.2	0.1	0.0	0.0	0.0	15.1	14.6	203.7	0.0	0.0	0.0	0.0	16.6	44.4
2002	0.0	12.8	16.7	44.7	15.6	18.4	6.2	0.0	0.0	0.0	8.7	146.1	363.0	322.6	9.3	---	0.0	1.6	193.6
2003	0.0	3.0	515.3	188.3	73.0	0.4	0.0	0.0	0.0	0.0	108.0	223.7	11.0	0.0	0.0	0.0	0.0	375.9	369.3
2004	0.0	35.7	60.1	334.2	1.5	0.1	0.0	0.0	0.1	0.0	453.3	44.5	5.0	42.6	126.7	0.0	0.0	417.2	359.4
2005	0.0	0.3	93.0	3.8	25.3	2.8	11.9	0.2	0.0	0.0	2.2	80.1	3.8	0.0	0.0	0.1	0.0	3.7	329.1
2006	0.0	0.4	0.0	0.0	0.3	9.0	7.2	0.0	1.7	0.0	1.9	0.0	2.4	3.0	4.0	3.9	0.0	0.5	0.4
2007	0.0	0.0	1.7	54.4	0.5	0.3	7.4	0.0	19.0	0.0	1.7	62.5	15.8	239.2	264.1	13.9	0.0	75.1	28.0
2008	---	0.3	0.9	2.1	5.8	0.1	59.2	155.4	18.0	---	9.6	30.6	178.9	64.6	---	26.8	---	10.1	10.2
2009	0.3	0.1	2.9	8.4	2.9	4.6	0.1	31.8	0.7	0.2	1.4	12.8	3.6	26.8	32.0	16.2	0.4	1.3	2.7
2010	0.0	0.9	8.3	15.2	1.3	0.1	45.5	0.0	0.0	0.0	16.0	3.8	2.8	0.9	35.8	0.2	0.0	5.7	4.0
2011	0.0	1.1	0.9	28.1	0.4	0.5	0.7	0.0	0.0	0.0	1.2	2.9	1.2	0.6	0.4	0.2	0.0	27.7	6.1

Table 4. (Continued).

	STATIONS																		
	6.3	**6.4**	**6.5**	**6.6**	**6.7**	**7.1**	**7.2**	**7.3**	**7.4**	**7.5**	**7.6**	**7.7**	**8.1**	**8.2**	**8.3**	**8.4**	**8.5**	**8.6**	**8.7**
STRATE / *STRATUM*	2	3	3	3	2	2	2	3	3	2	2	1	1	2	3	3	3	2	1
LONGITUDE	-63.25	-63.25	-63.25	-63.25	-63.25	-63.75	-63.75	-63.75	-63.75	-63.75	-63.75	-63.75	-64.37	-64.25	-64.25	-64.25	-64.25	-64.08	-64.08
LATITUDE	47.17	47.50	47.83	48.17	48.50	46.83	47.17	47.50	47.83	48.17	48.50	48.83	46.83	47.17	47.50	47.83	48.17	48.50	48.75
1979	217.6	115.1	50.4	7.8	4.2	335.1	283.4	267.2	24.0	8.4	6.4	---	---	494.2	345.1	173.4	16.5	15.5	---
1983	95.0	100.1	291.4	104.0	10.2	46.5	11.2	91.8	79.2	68.7	19.2	50.7	8.3	78.0	66.6	36.3	12.2	15.7	12.8
1984	290.4	396.2	337.7	220.2	2.3	55.6	48.0	122.3	239.6	312.1	373.2	72.5	15.1	28.2	210.8	368.5	519.8	166.1	39.6
1985	104.4	703.6	279.0	835.5	51.8	429.0	398.8	695.1	773.2	421.0	313.4	13.8	46.4	---	379.2	458.9	173.3	47.5	134.8
1986	319.9	581.9	965.3	1 099.5	282.5	1 916.1	1 132.5	284.9	203.5	1 029.8	484.2	7.2	105.7	455.6	901.3	1 726.7	442.6	449.6	47.0
1987	73.6	349.0	529.7	280.9	147.5	17.0	136.9	402.3	718.6	267.0	0.3	1.9	1.6	137.4	225.7	2 447.1	84.9	111.9	11.4
1988	477.0	234.5	889.5	28.0	0.3	103.4	445.3	704.8	209.6	165.0	98.5	0.1	9.3	739.8	639.9	676.5	1 434.7	607.6	49.4
1989	77.6	285.4	15.8	27.4	23.4	35.0	147.5	415.8	312.1	783.2	69.7	1.5	0.0	87.4	452.3	347.9	123.7	5.9	3.7
1990	67.3	241.6	114.8	270.7	0.3	112.7	711.0	190.6	278.0	45.4	1.0	3.5	1.3	307.4	233.6	658.4	291.2	34.4	7.5
1991	41.2	1 199.6	1 156.4	2.5	0.0	---	272.3	123.9	253.8	248.3	0.0	0.5	11.2	219.1	598.9	295.7	1 317.2	52.2	274.2
1992	86.5	244.9	1 138.6	513.9	0.0	148.1	102.6	687.6	154.0	752.2	16.5	0.0	1.5	64.4	290.7	1 216.1	755.9	9.6	49.5
1993	279.3	434.5	956.4	237.0	16.6	489.4	968.0	604.0	143.9	71.8	0.8	---	105.5	1 590.9	1 330.6	87.1	248.6	13.7	---
1994	38.0	777.4	63.0	35.6	0.0	386.3	136.0	1 146.2	118.9	197.0	4.3	0.2	33.2	349.9	280.0	169.4	86.0	144.3	2.6
1996	272.9	60.3	14.1	0.2	0.0	63.5	20.5	20.9	43.4	77.6	---	0.0	0.9	7.7	264.1	28.9	117.5	15.1	0.4
1998	48.1	54.0	52.8	7.3	11.6	17.3	68.7	6.1	101.5	11.9	0.0	0.0	1.5	26.8	31.7	27.2	36.1	0.1	0.0
2000	21.8	23.4	98.4	0.0	0.3	204.3	44.3	70.6	1 136.3	11.3	0.0	0.0	0.4	27.7	22.0	54.6	91.0	0.4	0.0
2002	296.7	238.6	11.2	0.0	0.0	298.0	313.0	221.1	1 046.8	48.4	0.4	0.0	15.9	100.6	130.3	81.4	334.8	0.0	0.0
2003	303.1	49.0	0.0	0.0	0.0	381.9	995.8	804.1	1.7	0.1	0.0	0.0	60.0	303.8	358.7	294.6	95.2	0.0	0.0
2004	103.9	0.0	45.9	0.7	0.1	605.6	198.0	0.9	0.0	0.0	0.0	0.0	---	135.7	4.8	41.0	2.6	0.0	0.0
2005	257.9	0.1	0.0	0.1	0.0	510.6	158.2	10.1	4.6	0.0	0.1	---	11.2	9.1	273.0	46.0	3.7	0.0	0.0
2006	0.5	61.6	42.9	10.3	16.8	0.1	1.7	3.6	7.0	9.0	2.7	3.3	0.5	16.2	121.1	8.5	3.9	15.3	4.8
2007	46.6	15.5	219.6	141.2	7.7	26.3	40.0	118.3	36.8	15.7	32.6	4.8	0.0	36.1	96.2	85.6	102.1	132.6	42.4
2008	132.1	51.3	---	302.9	---	29.9	85.3	241.2	---	46.0	5.9	0.2	5.1	68.7	155.1	376.1	50.5	3.7	1.8
2009	29.0	78.2	3.2	2.9	0.0	10.3	25.4	100.0	61.1	10.1	238.5	0.2	23.2	21.3	40.2	335.9	31.6	---	---
2010	0.2	0.0	0.0	0.0	0.0	14.7	3.9	40.4	0.9	1.5	0.0	0.0	31.3	19.6	28.5	0.7	0.1	59.5	1.3
2011	5.8	0.3	0.3	1.7	0.1	18.8	2.1	0.6	43.0	9.3	11.1	4.9	0.8	69.4	102.8	21.0	2.3	15.9	10.5

Table 4. (Continued).

	STATIONS								STATISTIQUES / *STATISTICS*					
	9.1	**9.2**	**9.3**	**9.4**	**9.5**	**10.1**	**11.1**	**12.1**						
STRATE / *STRATUM*	1	1	2	2	3	2	3	3	**Moyenne / *Mean***	**É.-T. / *STD***	**Min.**	**Max.**	**Étendue / *Range***	**n**
LONGITUDE	-64.67	-64.75	-64.67	-64.75	-64.75	-65.25	-65.75	-66.13						
LATITUDE	46.83	47.17	47.50	47.93	48.17	47.93	48.00	48.05						
1979	---	8.1	197.8	92.8	103.2	106.7	361.1	1 273.0	131.1	211.8	0.0	1273.0	1273.0	59
1983	69.4	16.8	36.1	21.9	31.0	6.8	82.9	0.8	86.8	161.7	0.2	997.3	997.2	64
1984	102.8	80.9	163.5	515.3	81.8	639.2	186.9	159.1	135.4	177.9	0.0	834.5	834.5	65
1985	6.6	3.5	303.7	377.5	772.0	419.8	743.7	345.4	206.7	231.6	0.0	835.5	835.5	64
1986	149.1	180.0	792.0	431.4	662.3	238.1	446.5	847.1	429.6	428.0	0.0	1916.1	1916.1	57
1987	28.9	11.9	84.5	626.4	504.7	90.2	605.3	330.3	193.1	348.6	0.3	2447.1	2446.8	65
1988	11.6	333.1	197.3	668.0	586.5	73.3	460.9	11.4	227.2	293.1	0.0	1434.7	1434.7	62
1989	0.0	30.5	348.6	42.5	267.1	113.4	533.1	2.0	111.5	202.8	0.0	1056.3	1056.3	65
1990	69.8	192.0	345.1	8.9	730.5	342.8	685.4	99.6	113.1	180.1	0.0	730.5	730.5	65
1991	200.4	488.0	650.6	194.9	1 158.4	36.4	513.9	30.8	213.6	345.0	0.0	1317.2	1317.2	63
1992	15.3	57.3	263.1	212.6	1 010.7	1 038.0	830.1	51.4	187.9	316.5	0.0	1216.1	1216.1	65
1993	466.0	329.8	631.2	222.4	352.5	77.1	234.2	110.4	177.2	319.1	0.0	1590.9	1590.9	63
1994	169.8	61.4	73.0	10.8	154.1	79.8	80.2	247.5	86.0	186.4	0.0	1146.2	1146.2	65
1996	1.5	0.7	29.6	0.5	49.6	39.2	23.9	0.8	31.4	56.1	0.0	272.9	272.9	64
1998	1.1	1.1	98.0	0.5	21.3	0.5	70.3	12.1	26.0	40.4	0.0	204.5	204.5	64
2000	58.0	7.8	103.2	13.5	30.8	12.8	57.7	0.7	38.7	145.4	0.0	1136.3	1136.3	64
2002	19.4	157.6	198.0	0.0	22.6	3.9	20.6	0.8	76.9	160.3	0.0	1046.8	1046.8	64
2003	139.9	87.0	330.8	98.7	5.8	3.4	269.1	10.9	104.0	192.7	0.0	995.8	995.8	65
2004	610.4	200.8	385.4	28.0	0.3	0.7	79.3	1.6	69.4	146.4	0.0	610.4	610.4	64
2005	99.3	187.9	279.2	0.2	0.0	0.7	8.3	---	41.7	97.7	0.0	510.6	510.6	61
2006	14.0	4.3	8.9	11.0	1.0	5.4	5.5	---	6.9	17.6	0.0	121.1	121.1	63
2007	1.0	4.7	25.3	16.0	642.9	317.1	25.8	1.5	47.6	100.7	0.0	642.9	642.9	65
2008	59.0	53.4	98.7	0.2	371.6	63.2	41.5	---	54.1	90.5	0.0	376.1	376.1	53
2009	51.5	47.4	215.3	29.9	5.0	20.3	10.3	0.9	27.6	61.8	0.0	335.9	335.9	63
2010	0.6	38.2	31.4	1.1	126.7	5.0	36.9	1.4	9.2	20.2	0.0	126.7	126.7	65
2011	0.8	102.4	392.2	0.8	12.4	9.1	14.6	1.1	14.5	52.2	0.0	392.2	392.2	64

Table 5. Daily egg production (stratified mean) (n/m^2) of Atlantic mackerel for the entire sampled area by the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.

ANNÉE / *YEAR*	RELEVÉ / *SURVEY**	NOMBRE DE STATIONS / *NUMBER OF STATIONS* Strate / *Stratum*			PRODUCTION QUOTIDIENNE D'ŒUFS / *DAILY EGG PRODUCTION* (n/m^2) Moyenne / *Average* Strate / *Stratum*			Variance Strate / *Stratum*			Moyenne stratifiée / *Stratified mean*	Variance de la moyenne / *Variance of the mean*
		1	2	3	m_1	m_2	m_3	v_1	v_2	v_3		
1979	P-221	21	23	15	21.0	144.5	264.8	548	21 655	113 473	122.9	603
1983	P-353	27	22	15	33.4	81.5	190.8	1 275	19 920	68 226	89.2	402
1984	N-030	27	23	15	29.0	149.6	305.0	1 086	30 198	42 126	138.3	325
1985	P-324	27	22	15	39.9	233.4	467.5	2 126	29 195	66 041	211.4	440
1986	P-337	19	23	15	101.6	493.4	747.3	11 593	175 825	180 688	391.9	1 675
1987	P-353	27	23	15	55.5	109.5	569.1	3 240	17 290	322 857	205.1	1 531
1988	P-369	25	22	15	59.7	277.6	432.4	9 123	69 142	155 619	224.7	1 071
1989	P-386	27	23	15	17.4	118.3	270.3	985	40 432	78 550	114.5	531
1990	P-400	27	23	15	21.7	105.0	290.0	1 701	29 333	49 342	117.2	358
1991	P-415	26	22	15	55.1	135.5	603.0	12 414	23 836	250 438	221.9	1 307
1992	P-430	27	23	15	16.4	193.2	488.5	623	82 033	174 440	194.1	1 134
1993	P-445	25	23	15	46.6	221.3	327.4	12 441	146 570	141 518	174.2	1 354
1994	N-209	27	23	15	12.2	86.4	218.4	1 178	15 577	102 952	88.8	533
1996	GE-001	27	22	15	8.1	35.3	67.6	166	3 514	6 109	32.1	44
1998	N-223	27	22	15	9.4	29.7	50.3	299	2 391	1 996	26.4	22
2000	MB	26	23	15	5.0	24.2	119.3	153	2 087	82 170	40.6	375
2002	MB	27	22	15	15.6	77.0	186.9	1 043	12 266	75 032	79.2	396
2003	Coriolis II	27	23	15	41.0	163.3	126.7	10 310	54 890	50 392	101.7	531
2004	Teleost	26	23	15	39.2	133.4	23.4	15 356	36 262	1 412	64.9	271
2005	Teleost	24	23	14	21.6	72.8	25.0	1 970	19 265	5 239	38.7	123
2006	Coriolis II	26	23	14	1.8	5.0	19.6	10	31	1 171	7.4	6
2007	Teleost	27	23	15	4.9	41.7	133.6	137	4 550	27 436	49.7	143
2008	Teleost	20	22	11	6.7	33.8	180.8	291	1 348	16 111	60.2	106
2009	Teleost	26	27	26	5.4	3.4	4.8	189	86	401	27.4	56
2010	Teleost	22	22	23	38.0	10.0	26.2	5 210	250	6 608	9.3	7
2011	Teleost	15	16	15	50.9	18.3	13.5	7 096	1 151	750	13.8	35

* P=E.E. Prince, N=Alfred Needler, GE=Grande-Entrée, MB=Martha L. Black

Table 6. Parameters of the variograms used for kriging the daily egg productions of the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.

ANNÉE / *YEAR*	MODÈLE* / *MODEL**	Pépite / *Nugget* (C_0)	Plateau / *Sill* ($C_0 + C$)	Étendue / *Range* (A_0)	R^2	RSS **
1979	Sphérique / *Spherical*	13150	42840	249.6	0.993	2.31E+06
1983	Sphérique / *Spherical*	10	7872	144.4	0.988	1.34E+06
1984	Sphérique / *Spherical*	8970	23700	256.8	0.935	9.34E+06
1985	Sphérique / *Spherical*	15200	59290	194.1	0.970	3.29E+07
1986	Sphérique / *Spherical*	6700	194700	79.0	0.924	3.07E+08
1987	Sphérique / *Spherical*	4200	130000	74.0	0.891	1.39E+08
1988	Exponentiel / *Exponential*	12800	101300	68.5	0.973	1.01E+08
1989	Sphérique / *Spherical*	1790	15690	143.4	0.960	2.73E+07
1990	Sphérique / *Spherical*	8340	24700	256.2	0.918	1.32E+07
1991	Sphérique / *Spherical*	10	28200	67.3	0.912	6.34E+07
1992	Sphérique / *Spherical*	50700	101500	182.3	0.910	1.46E+08
1993	Exponentiel / *Exponential*	17100	127800	201.1	0.973	2.46E+08
1994	Sphérique / *Spherical*	10	20890	110.1	0.974	5.72E+06
1996	Sphérique / *Spherical*	1	1930	119.6	0.942	2.31E+05
1998	Sphérique / *Spherical*	1	844.1	99.3	0.955	1.33E+04
2000	Sphérique / *Spherical*	351	702	189.8	0.938	3.42E+03
2002	Sphérique / *Spherical*	810	11340	188.9	0.989	5.47E+05
2003	Sphérique / *Spherical*	10	22910	231.7	0.974	8.76E+06
2004	Sphérique / *Spherical*	1510	4712	216.1	0.939	3.76E+05
2005	Sphérique / *Spherical*	10	4875	121.5	0.905	1.90E+06
2007	Sphérique / *Spherical*	10	9924	105.6	0.947	1.54E-06
2008	Sphérique / *Spherical*	10	7849	90.4	0.827	4.89E-06
2009	Sphérique / *Spherical*	10	3540	53.9	0.934	1.81E+05
2010	Sphérique / *Spherical*	1	347	60.4	0.864	4.88E+03
2011	Sphérique / *Spherical*	1	434	127.0	0.900	7.33E+03

* Sphérique / *Spherical* $\gamma(h) = \begin{cases} C0 + C\left[1.5\left(\frac{h}{A_0}\right) - 0.5\left(\frac{h}{A_0}\right)^3\right] & \text{if } h \le A_0, \text{ et / and} \\ C0 + C & \text{autrement / otherwise} \end{cases}$

Exponentiel / *Exponential* $\gamma(h) = C0 + C\left[1 - \exp\left(-\frac{h}{A_0}\right)\right]$

** Somme des carrés des résidus / *Residual sum of squares*

Table 7. Daily egg production (kriged mean) (n/m^2) of Atlantic mackerel for the entire sampled area by the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.

ANNÉE / *YEAR*	NOMBRE-*NUMBER* / m^2			INTERVALLE CONFIANCE 95 % *95% CONFIDENCE INTERVAL*	
	Moyenne / Average	Variance	CV	Limite inférieure / *Lower limit*	Limite supérieure / *Upper Limit*
1979	121.51	260.82	0.13	89.86	153.17
1983	90.33	2.23	0.02	87.41	93.26
1984	135.91	102.07	0.07	116.11	155.72
1985	203.77	284.18	0.08	170.72	236.81
1986	428.27	1144.24	0.08	361.97	494.57
1987	200.98	468.67	0.11	158.55	243.41
1988	232.81	774.82	0.12	178.26	287.37
1989	114.26	18.39	0.04	105.86	122.67
1990	112.13	95.74	0.09	92.95	131.30
1991	219.46	30.75	0.03	208.59	230.33
1992	183.57	838.72	0.16	126.81	240.34
1993	178.37	547.21	0.13	132.52	224.21
1994	89.01	21.59	0.05	79.90	98.12
1996	32.83	1.45	0.04	30.47	35.19
1998	27.17	0.87	0.03	25.34	28.99
2000	73.13	0.18	0.01	72.30	73.97
2002	82.48	7.84	0.03	76.99	87.97
2003	108.62	8.44	0.03	102.93	114.32
2004	77.26	4.75	0.03	72.99	81.53
2005	44.46	5.35	0.05	39.93	49.00
2007	46.26	21.94	0.10	37.08	55.44
2008	59.12	37.19	0.10	47.17	71.07
2009	29.25	14.04	0.13	21.91	36.60
2010	8.53	1.26	0.13	6.33	10.73
2011	15.16	4.67	0.14	10.92	19.39

Table 8. Parameters of the logistic model used to describe the daily changes in the mean gonadosomatic index values of the spawning seasons of 1979 and from 1983 to 2011.

ANNÉE / *YEAR*	PARAMÈTRES MODÈLE LOGISTIQUE* / *PARAMETERS LOGISTIC MODEL**				Date médiane des relevés / *Median date of the surveys*	S**
	a	b	x0	y0		
1979	13.0575	14.4975	177.8867	0.0284	166.5	0.0177
1983	11.5863	33.1683	172.4413	0.6522	177.5	0.0357
1984	13.0000	19.6315	174.0580	0.5018	176.0	0.0270
1985	13.9005	16.2356	175.2628	0.3617	176.5	0.0228
1986	14.4193	15.3273	174.1798	0.3934	172.5	0.0221
1987	12.0224	20.1395	172.4082	0.5056	172.5	0.0291
1988	13.3372	26.6142	174.2490	0.5521	172.5	0.0381
1989	17.0650	11.4019	170.7835	0.2361	174.5	0.0161
1990	13.3555	14.3253	178.2834	0.4319	170.0	0.0192
1991***	18.1154	12.2182	167.6766	0.5171	172.0	0.0232
1992	12.6668	19.0768	176.9768	0.5655	172.0	0.0263
1993	12.8226	17.6929	180.0840	0.6077	170.0	0.0211
1994	11.6671	23.9986	175.9399	0.6016	168.5	0.0284
1996	14.4765	21.7761	172.6301	0.4623	172.5	0.0314
1998	14.0552	22.0477	167.9536	0.5520	167.0	0.0328
2000	13.0333	19.7498	173.2550	0.3784	174.0	0.0279
2002	14.3553	16.4767	169.6161	0.4487	171.5	0.0237
2003	14.4720	23.5582	170.7031	0.4759	171.5	0.0340
2004	10.5535	29.0933	175.5954	0.5096	169.5	0.0345
2005	16.0325	26.6581	173.7021	0.4628	170.0	0.0373
2006	14.9748	21.7965	167.4634	0.4492	184.0	0.0108
2007	12.3435	38.2537	176.9876	0.5289	176.0	0.0539
2008	10.3455	39.5329	176.6838	0.5034	176.5	0.0543
2009	11.4965	29.1543	174.0404	0.4101	168.5	0.0361
2010	13.0345	21.8685	170.4039	0.4374	168.0	0.0321
2011	18.2367	22.6462	166.6338	0.4072	166.0	0.0339

* $$y = y_0 + \frac{a}{\left[1 + \left(\frac{x}{x_0}\right)^b\right]}$$

** Proportion journalière de la production d'œufs associée à la date médiane des relevés / *Daily proportion of the egg production associated with the median date of the surveys*

*** Une correction a été apportée pour forcer la présence d'un plateau aux valeurs les plus élevées de l'indice gonado-somatique / *A correction was applied to force the presence of a plateau for the highest gonadosomatic index values*

Table 9. Characteristics of the Atlantic mackerel spawning seasons according to the model describing the proportion of eggs spawned daily.

ANNÉE / *YEAR*	JOUR DE L'ANNÉE / *DAY OF THE YEAR*			
	f(x :)=2.5%	f(xi) Max.	f(x :)=97.5%	Durée Ponte (D)* / *Spawning Duration (D) **
1979	138	176	229	91
1983	154	172	192	38
1984	144	173	209	65
1985	140	174	219	79
1986	137	173	221	84
1987	163	172	206	43
1988	152	174	200	48
1989	155	168	235	80
1990	165	177	230	65
1991	153	166	226	73
1992	146	176	214	68
1993	146	179	221	75
1994	168	175	205	37
1996	164	172	204	40
1998	159	167	198	39
2000	163	172	208	45
2002	158	168	211	53
2003	163	170	199	36
2004	169	175	199	30
2005	166	173	199	33
2006	159	167	198	39
2007	171	177	194	23
2008	171	176	193	22
2009	167	174	197	30
2010	162	170	194	32
2011	158	166	189	31
Min.	137	166	189	22
Moyenne / *Ave rage*	157	172	207	50
Max.	171	179	235	91

* Durée de la ponte (D) / *Spawning duration* (D): $X_{i=97.5} - X_{i=2.5}$

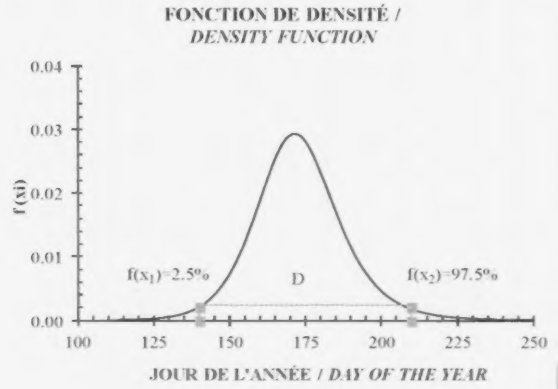


Table 10. Total daily egg production (n) of the Atlantic mackerel for the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2011.

ANNÉE / YEAR	RELEVÉ / SURVEY*	PRODUCTION TOTALE D'ŒUFS / TOTAL EGG PRODUCTION				
				INTERVALLE CONFIANCE (95 %) / CONFIDENCE INTERVAL (95%)		
		n	Variance	L. Inf. / Lower L.	L. Sup. / Upper L.	CV
1979	P-221	8.54E+12	2.91E+24	5.19E+12	1.19E+13	19.98
1983	P-353	6.19E+12	1.94E+24	3.47E+12	8.92E+12	22.47
1984	N-030	9.61E+12	1.57E+24	7.15E+12	1.21E+13	13.04
1985	P-324	1.47E+13	2.12E+24	1.18E+13	1.75E+13	9.92
1986	P-337	2.72E+13	8.08E+24	2.16E+13	3.28E+13	10.44
1987	P-353	1.42E+13	7.39E+24	8.92E+12	1.96E+13	19.07
1988	P-369	1.56E+13	5.16E+24	1.11E+13	2.01E+13	14.56
1989	P-386	7.96E+12	2.56E+24	4.82E+12	1.11E+13	20.11
1990	P-400	8.14E+12	1.72E+24	5.57E+12	1.07E+13	16.13
1991	P-415	1.54E+13	6.31E+24	1.05E+13	2.03E+13	16.29
1992	P-430	1.35E+13	5.47E+24	8.89E+12	1.81E+13	17.35
1993	P-445	1.21E+13	6.53E+24	7.09E+12	1.71E+13	21.12
1994	N-209	6.17E+12	2.57E+24	3.03E+12	9.31E+12	25.99
1996	GE-001	2.23E+12	2.13E+23	1.32E+12	3.13E+12	20.73
1998	N-223	1.83E+12	1.05E+23	1.20E+12	2.47E+12	17.67
2000	MB	2.82E+12	1.81E+24	1.81E+11	5.45E+12	47.75
2002	MB	5.50E+12	1.91E+24	2.79E+12	8.21E+12	25.12
2003	Coriolis II	7.06E+12	2.56E+24	3.93E+12	1.02E+13	22.66
2004	Teleost	4.50E+12	1.30E+24	2.27E+12	6.74E+12	25.36
2005	Teleost	2.68E+12	5.94E+23	1.17E+12	4.20E+12	28.72
2006	Coriolis II	5.12E+11	2.79E+22	1.85E+11	8.40E+11	32.58
2007	Teleost	3.45E+12	6.87E+23	1.83E+12	5.08E+12	24.01
2008	Teleost	4.18E+12	5.13E+23	2.78E+12	5.58E+12	17.13
2009	Teleost	1.90E+12	2.72E+23	8.82E+11	2.93E+12	27.39
2010	Teleost	6.48E+11	3.14E+22	3.01E+11	9.95E+11	27.34
2011	Teleost	9.58E+11	1.68E+23	1.56E+11	1.76E+12	42.71

* P=E.E. Prince; N=Alfred Needler; GE=Grande-Entrée; MB=Martha L. Black

Table 11. Proportion of females, mean weight (g) of a fish, and mean fecundity used for the calculation of the Atlantic mackerel spawning biomass index.

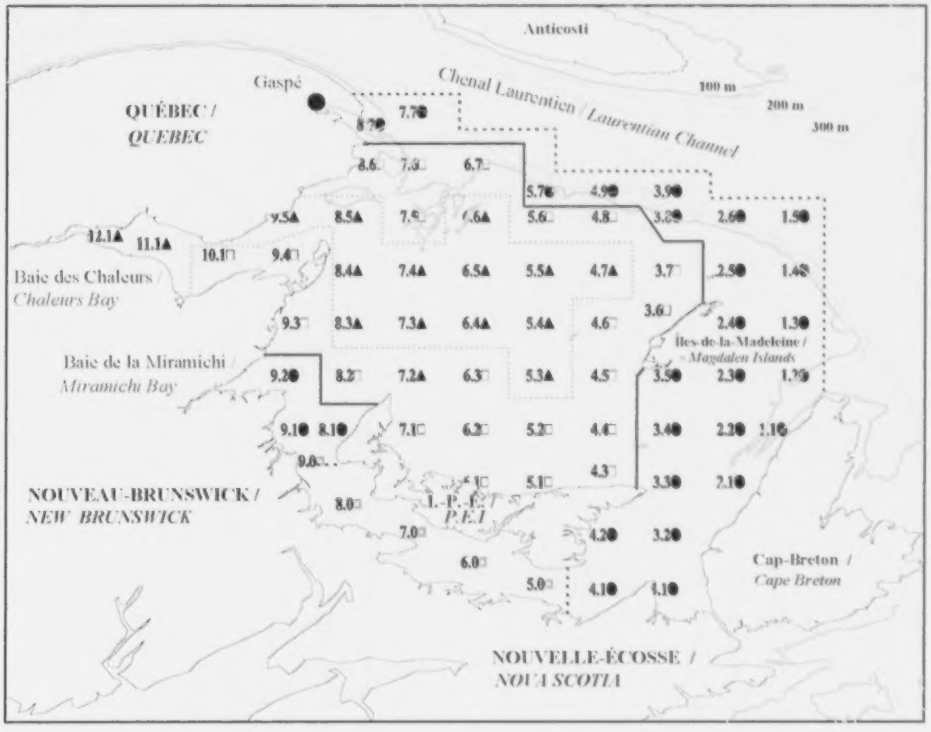
ANNÉE / *YEAR*	PROPORTION		POIDS / *WEIGHT* (g)		FÉCONDITÉ / *FECUNDITY*	
	Femelle / *Female*	Variance	Moyenne / *Average*	Variance	Moyenne / *Average*	Variance
1979	0.5171	0.0004	559.3	3 339	634 155	2.82E+10
1983	0.5183	0.0005	473.6	22 419	462 421	1.19E+10
1984	0.5124	0.0011	523.7	28 454	501 014	4.76E+10
1985	0.5115	0.0009	526.2	47 179	544 311	4.90E+10
1986	0.5120	0.0006	433.2	13 851	593 853	6.14E+10
1987	0.5150	0.0007	458.1	9 992	499 572	3.17E+10
1988	0.5193	0.0005	561.0	10 753	598 637	2.29E+10
1989	0.5155	0.0010	560.4	13 097	703 542	2.81E+10
1990	0.5108	0.0007	487.7	26 437	553 083	3.34E+10
1991	0.5207	0.0008	456.8	17 467	462 272	2.53E+10
1992	0.5072	0.0004	404.0	21 204	499 101	2.39E+10
1993	0.5096	0.0005	480.7	13 495	580 252	3.09E+10
1994	0.5013	0.0008	514.1	11 014	469 731	2.83E+10
1996	0.5203	0.0005	528.0	24 221	582 107	2.51E+10
1998	0.5077	0.0008	471.3	21 565	489 902	1.08E+10
2000	0.5185	0.0012	466.1	20 430	561 074	2.18E+10
2002	0.5053	0.0009	380.5	14 275	450 159	1.43E+10
2003	0.5179	0.0007	423.1	7 275	553 256	1.60E+10
2004	0.5176	0.0009	352.7	3 524	546 061	1.63E+10
2005	0.5089	0.0012	354.3	10 519	569 694	1.43E+05
2006	0.5106	0.0011	348.8	13 224	598 761	1.97E+05
2007	0.5142	0.0006	341.3	10 642	554 931	1.97E+10
2008	0.5144	0.0008	338.9	10 821	511 405	1.26E+05
2009	0.5084	0.0008	342.2	7 065	481 941	1.22E+05
2010	0.5142	0.0007	350.4	7 889	530 018	1.28E+05
2011	0.5109	0.0007	335.5	8 840	520 156	1.60E+05

Table 12. Spawning biomass index (t) of Atlantic mackerel according to two different approaches (TEPM: Total Egg Production Method; DFRM: Daily Fecundity Reduction Method).

ANNÉE / YEAR	RELEVÉ / SURVEY*	MÉTHODE DE LA PRODUCTION TOTALE D'ŒUFS (MPTO) / TOTAL EGG PRODUCTION METHOD (TEPM)			MÉTHODE DE LA RÉDUCTION JOURNALIÈRE DE LA FÉCONDITÉ (MRJF) / DAILY FECUNDITY REDUCTION METHOD (DFRM)		
		BIOMASSE REPRODUCTRICE (t) / SPAWNING BIOMASS (t)	INTERVALLE CONFIANCE (95 %) / CONFIDENCE INTERVAL (95%) L. Inf. / Lower L.	L. Sup. / Upper L.	BIOMASSE REPRODUCTRICE (t) / SPAWNING BIOMASS (t)	INTERVALLE CONFIANCE (95 %) / CONFIDENCE INTERVAL (95%) L. Inf. / Lower L.	L. Sup. / Upper L.
1979	P-221	820 554	670 391	970 718			
1983	P-353	342 591	260 329	424 853			
1984	N-030	726 183	516 577	935 790			
1985	P-324	1 217 178	848 625	1 585 732			
1986	P-337	1 754 052	1 293 813	2 214 290			
1987	P-353	872 703	662 915	1 082 490			
1988	P-369	739 208	603 293	875 123			
1989	P-386	757 877	607 657	908 098			
1990	P-400	725 415	536 492	914 337			
1991	P-415	1 284 928	969 028	1 600 829			
1992	P-430	796 459	581 190	1 011 727			
1993	P-445	935 545	726 633	1 144 456			
1994	N-209	467 261	350 826	583 696			
1996	GE-001	128 149	99 446	156 852	166 903	43 384	290 423
1998	N-223	103 242	80 323	126 161	66 768	18 387	115 148
2000	MB	165 017	112 662	217 373	207 302	0	441 429
2002	MB	379 070	281 852	476 288	359 330	64 642	654 017
2003	Coriolis II	314 752	254 150	375 355			
2004	Teleost	162 714	129 616	195 812			
2005	Teleost	86 487	67 790	105 183			
2006	Coriolis II	54 133	41 263	67 004			
2007	Teleost	76 532	18 345	18 345			
2008	Teleost	99 631	22 235	22 235			
2009	Teleost	73 743	14 050	14 050			
2010	Teleost	25 960	5 016	5 016			
2011	Teleost	35 714	9 441	9 441			

* P=E.E. Prince; N=Alfred Needler; GE=Grande-Entrée; MB=Martha L. Black

FIGURES



LÉGENDE / *LEGEND:*

- ● Strate / *Stratum 1*
- □ Strate / *Stratum 2*
- ▲ Strate / *Stratum 3*

Figure 1. Map of the stations and strata of the Atlantic mackerel egg survey conducted in the southern Gulf of St. Lawrence (stations sampled in the Northumberland Strait between 2006 and 2009 are indicated by □).

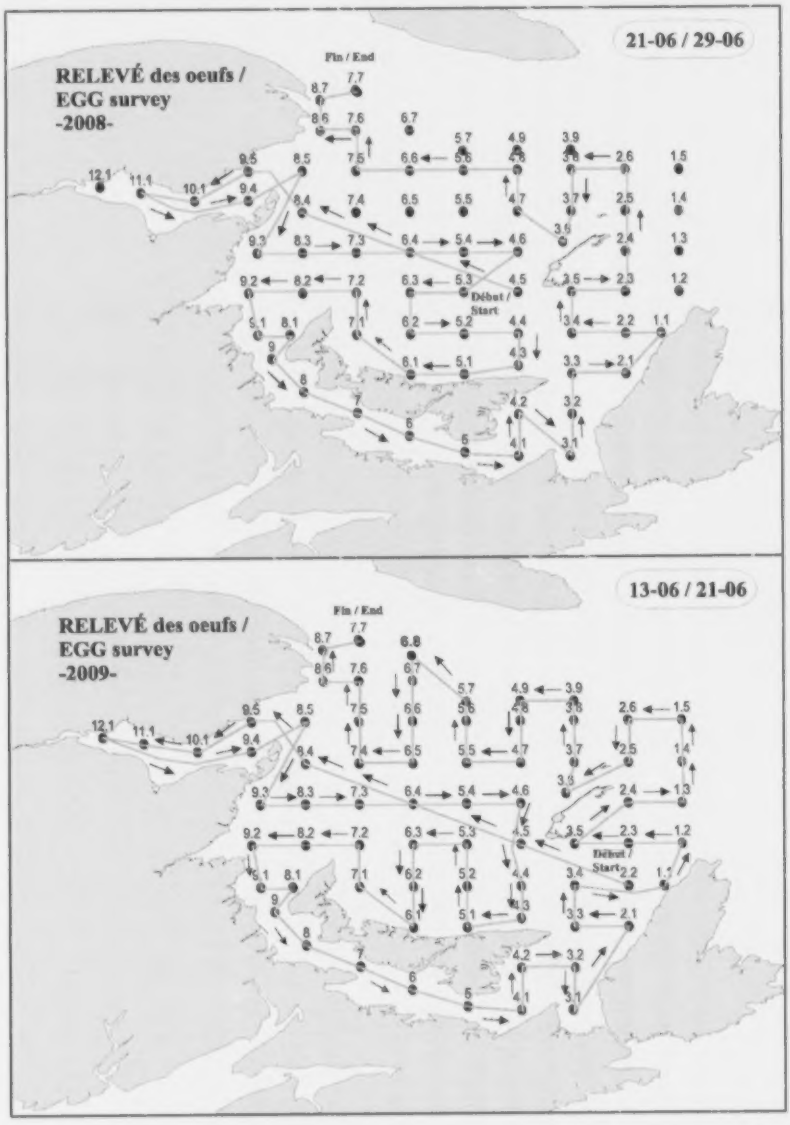


Figure 2. Sampling patterns of the Atlantic mackerel egg surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011.

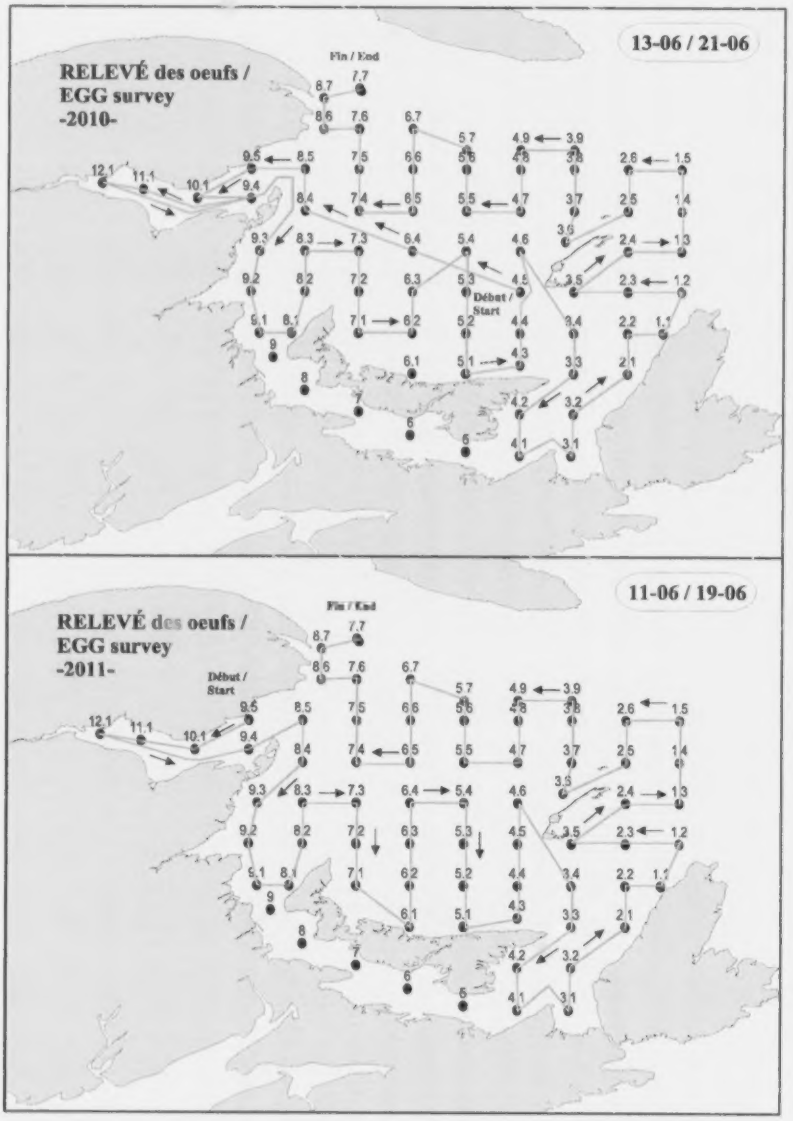
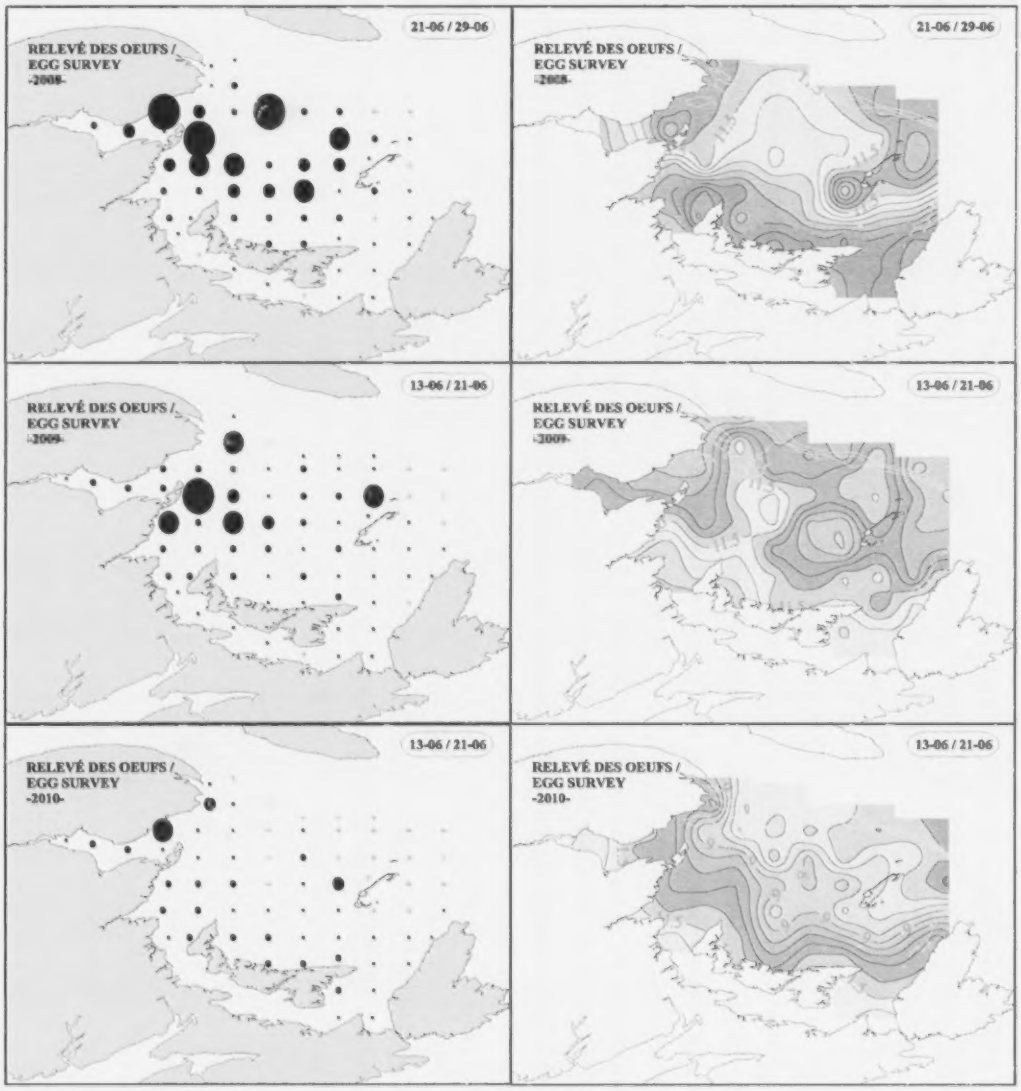


Figure 2. (Continued).



LÉGENDE / *LEGEND:*

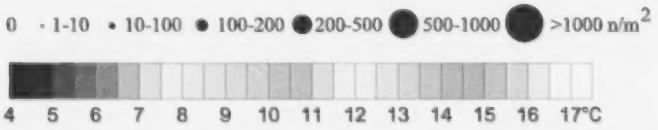
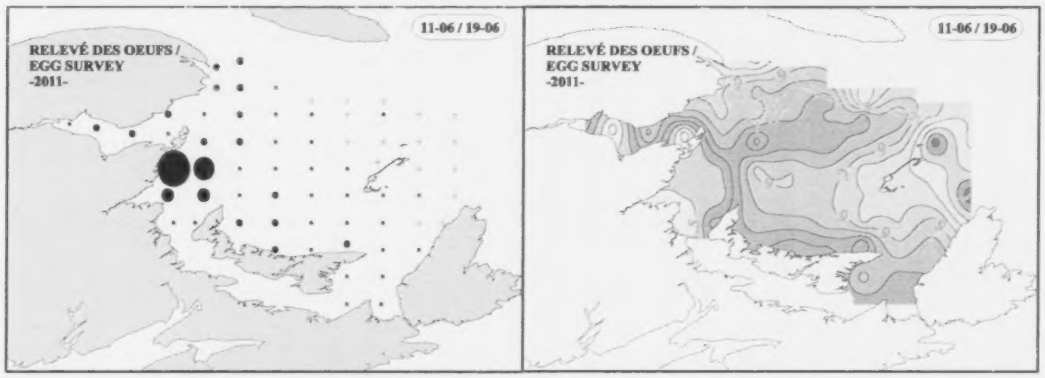


Figure 3. Distribution of the Atlantic mackerel egg abundances (n/m^2) and water temperatures (°C) (mean 0-10 m) for the research surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011.



LÉGENDE / *LEGEND:*

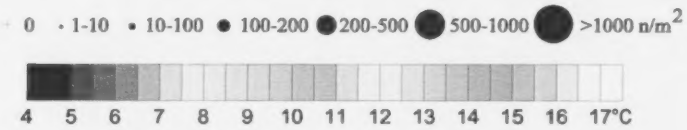


Figure 3. (Continued).

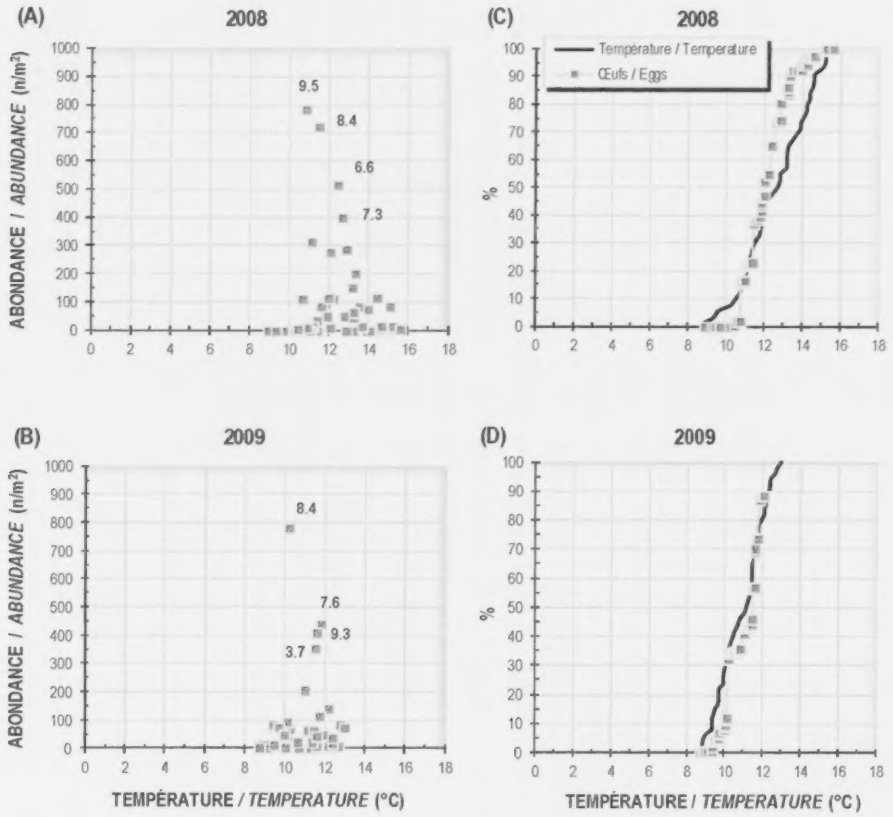


Figure 4. Relationships between egg abundance (n/m^2) and water temperature (°C) (mean 0-10 m) (the stations with the highest abundances are indicated) (A = 2008; B = 2009) and cumulative curves of the abundance data in relation to water temperature (C and D) for the research surveys conducted in the southern Gulf of St. Lawrence in 2008 and 2009.

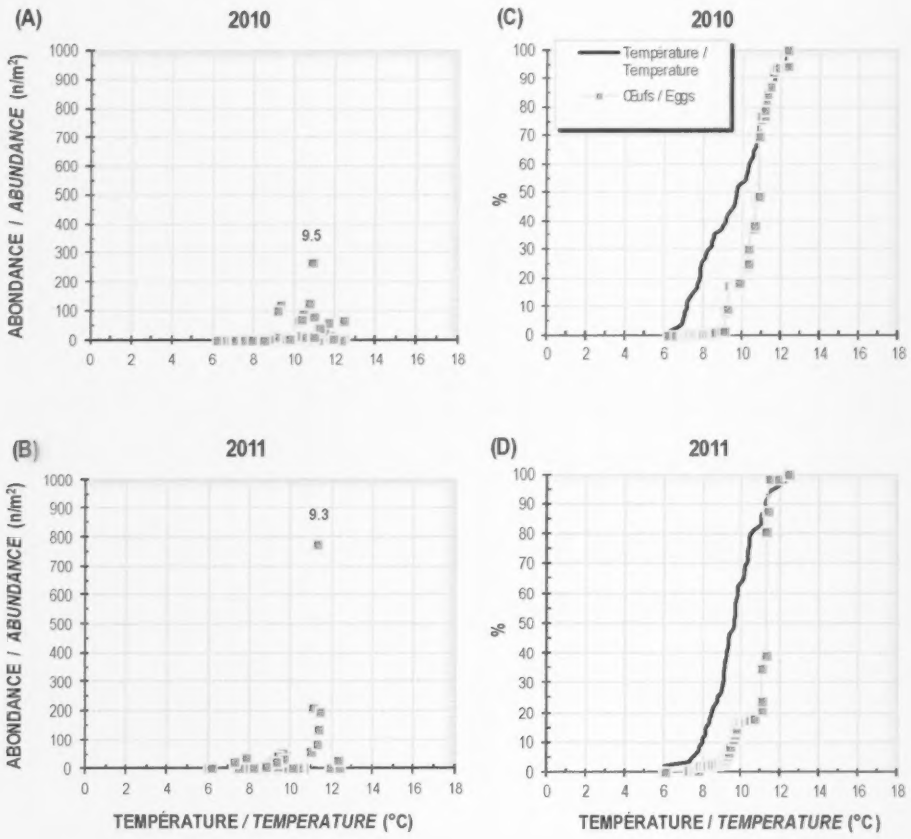


Figure 5. Relationships between egg abundance (n/m^2) and water temperature (°C) (mean 0-10 m) (the stations with the highest abundances are indicated) (A = 2010; B = 2011) and cumulative curves of the abundance data in relation to water temperature (C and D) for the research surveys conducted in the southern Gulf of St. Lawrence in 2010 and 2011.

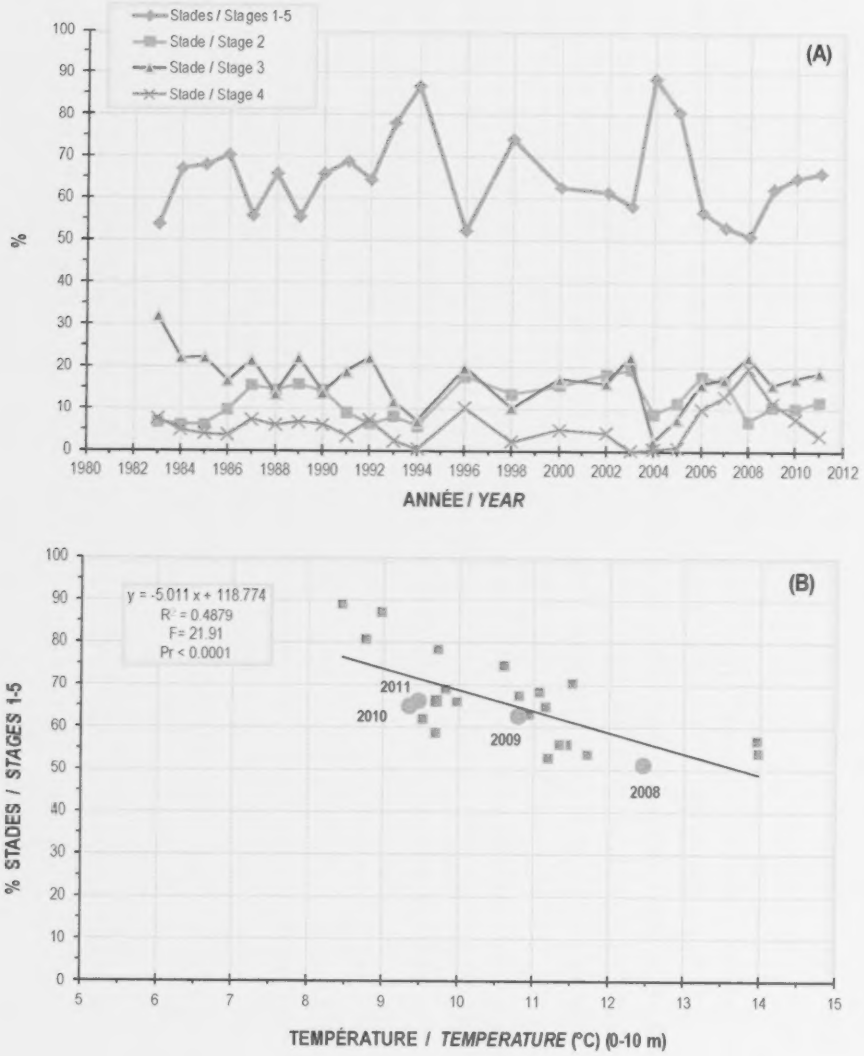


Figure 6. Mean annual percentages of Atlantic mackerel egg abundances (n/m^2) by stage of development (A) and relationship with the mean water temperature (°C) (0-10 m) (B) for the research surveys conducted from 1983 to 2011 (surveys from 2008 to 2011 are indicated).

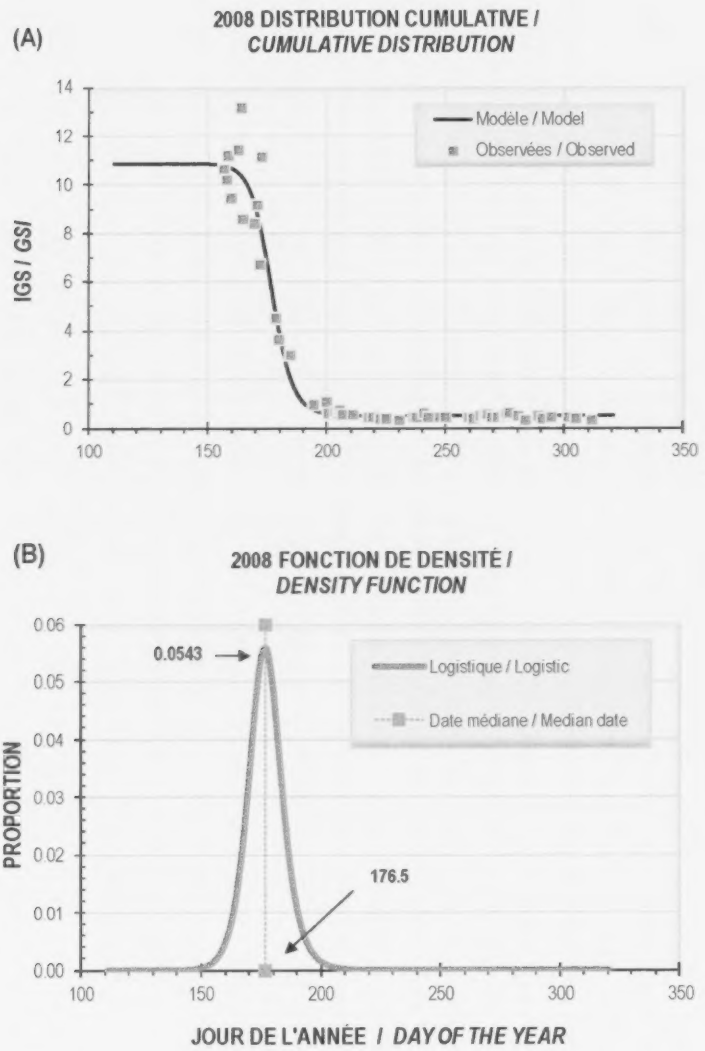


Figure 7. Gonadosomatic index (GSI) (observed and expected values) (A) and density curve (B) describing the proportion of eggs spawned daily in 2008 (the median date of the egg survey and the proportion associated to this date are indicated).

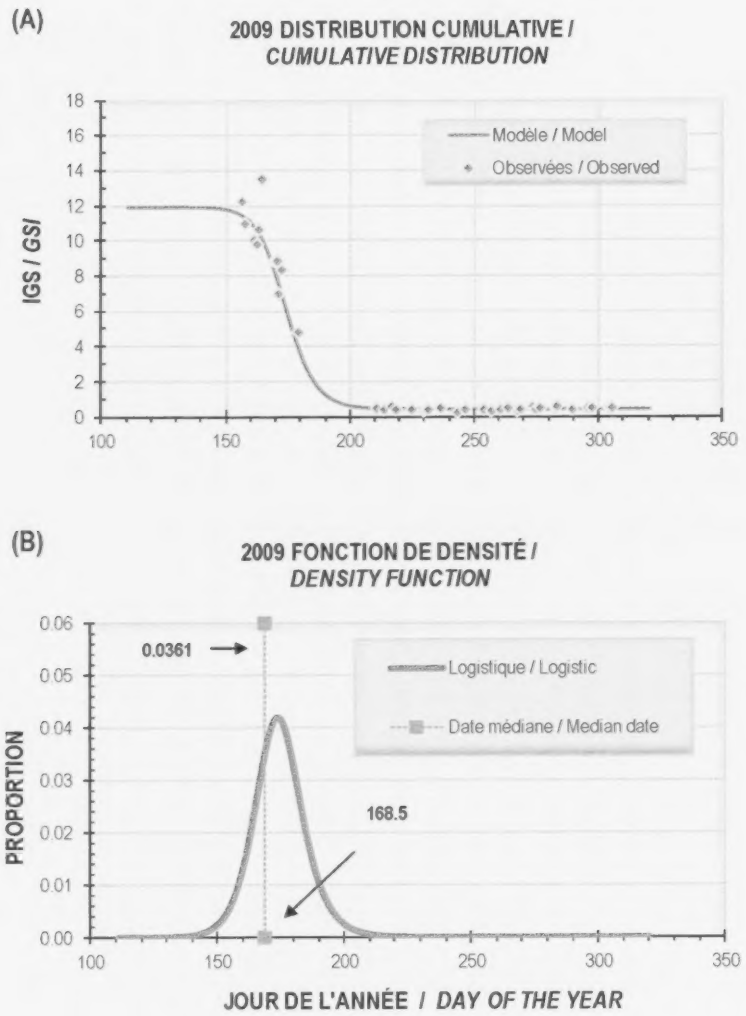


Figure 8. Gonadosomatic index (GSI) (observed and expected values) (A) and density curve (B) describing the proportion of eggs spawned daily in 2009 (the median date of the egg survey and the proportion associated to this date are indicated)

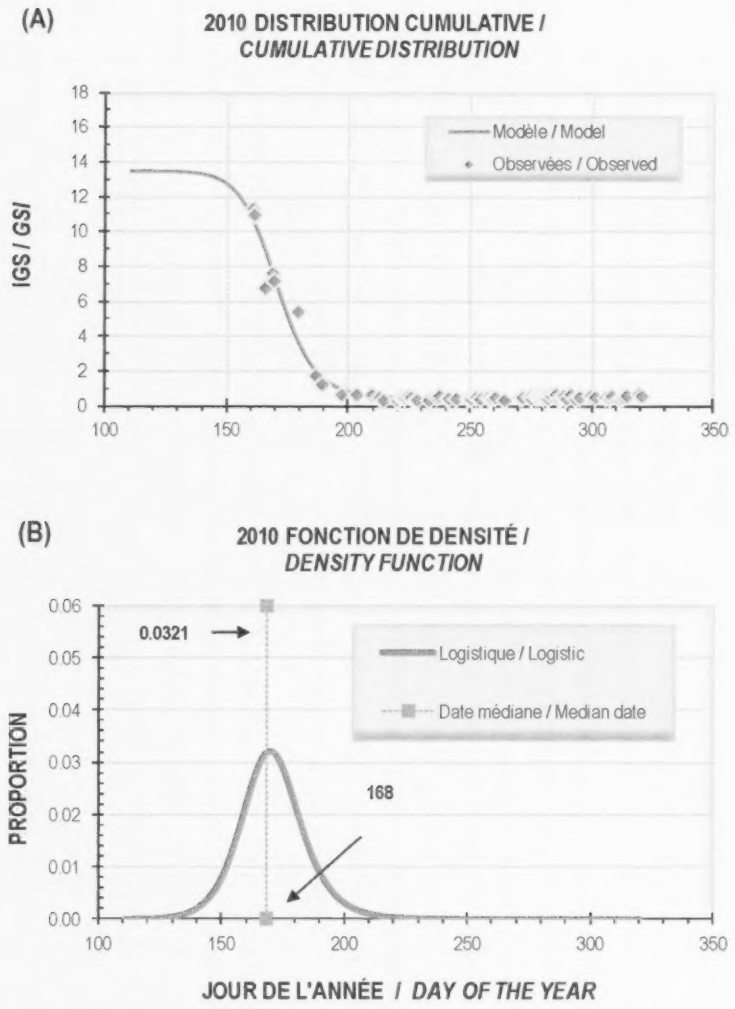


Figure 9. Gonadosomatic index (GSI) (observed and expected values) (A) and density curve (B) describing the proportion of eggs spawned daily in 2010 (the median date of the egg survey and the proportion associated to this date are indicated).

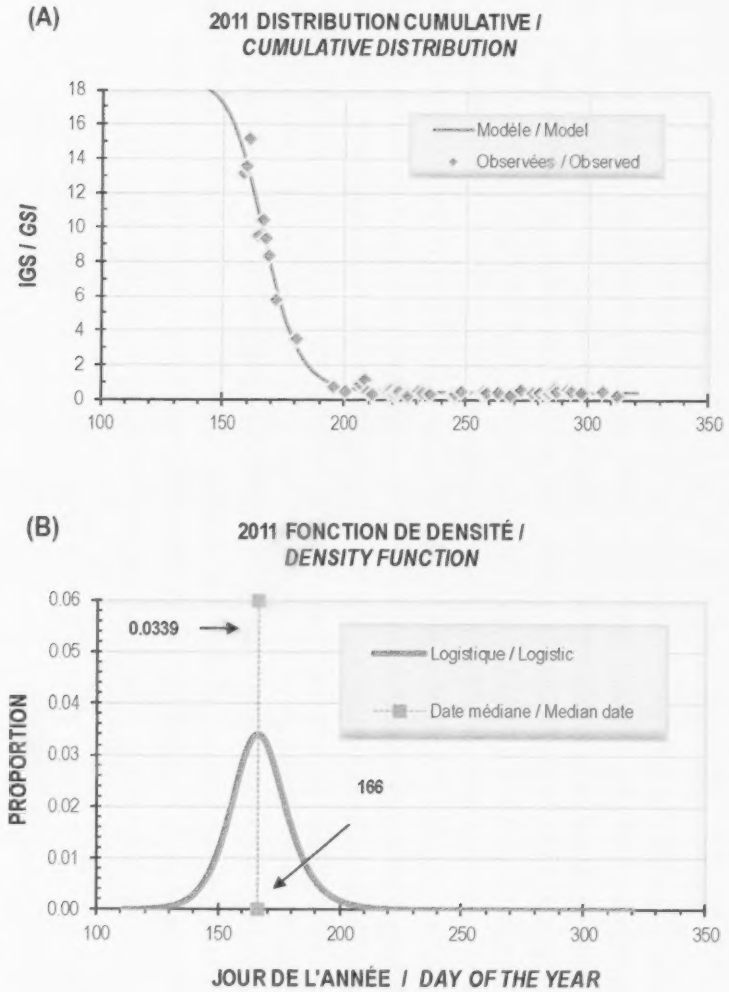


Figure 10. Gonadosomatic index (GSI) (observed and expected values) (A) and density curve (B) describing the proportion of eggs spawned daily in 2011 (the median date of the egg survey and the proportion associated to this date are indicated).

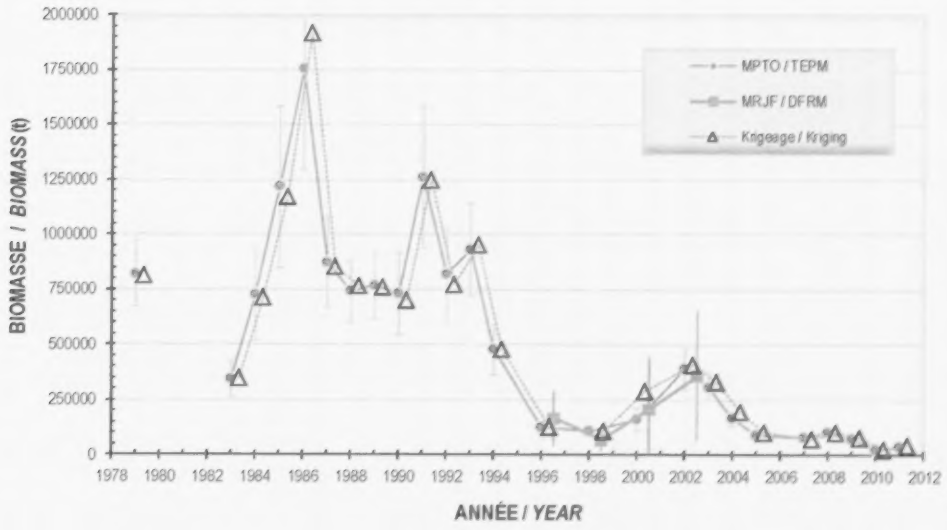
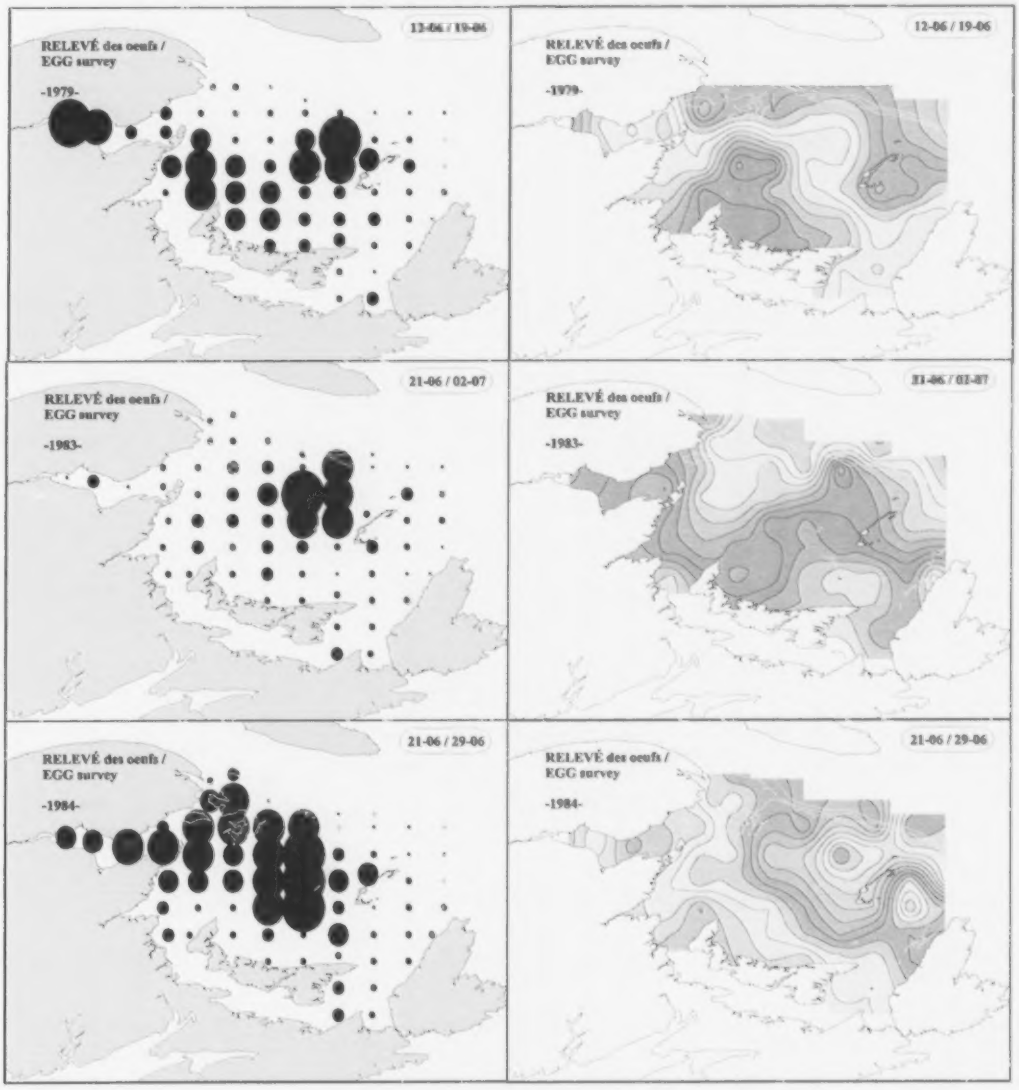


Figure 11. Index of the spawning biomass (t) of Atlantic mackerel calculated from the data of the egg surveys conducted in the southern Gulf of St. Lawrence according to two different approaches (TEPM: Total Egg Production Method; DFRM: Daily Fecundity Reduction Method) and technics (stratified and kriged averages of the daily egg productions).

Figure 12. Distribution of the Atlantic mackerel larvae abundances (n/m²) for the research surveys conducted in the southern Gulf of St. Lawrence from 2008 to 2011.

APPENDICES

Appendix 1. *Distribution of the Atlantic mackerel egg abundances (n/m^2) and water temperature (°C) (mean 0-10 m) for the research surveys conducted in the southern Gulf of St. Lawrence in 1979 and from 1983 to 2007.*

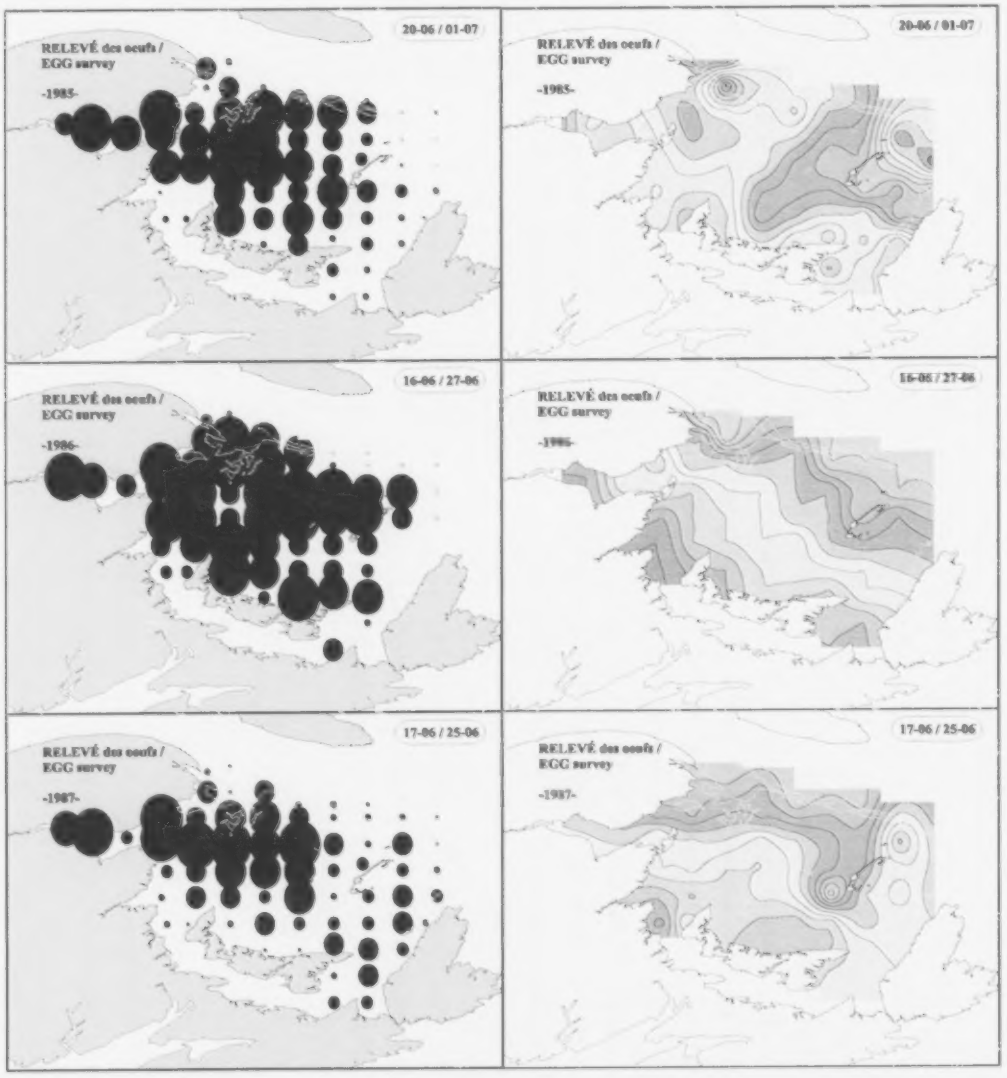


LÉGENDE / *LEGEND:*

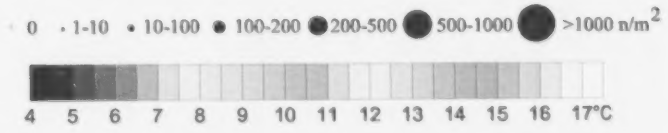
0 · 1-10 • 10-100 ● 100-200 ● 200-500 ● 500-1000 ● >1000 n/m^2

4 5 6 7 8 9 10 11 12 13 14 15 16 17°C

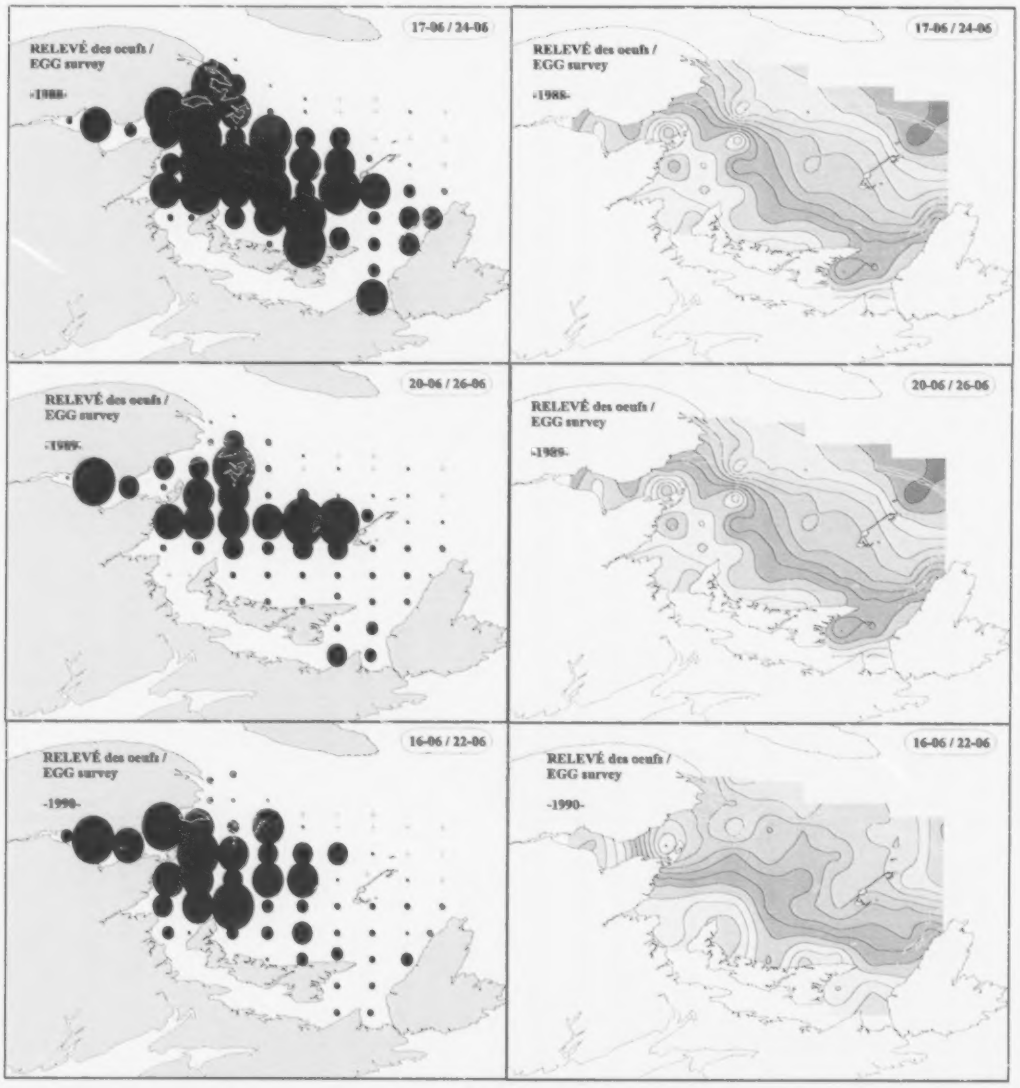
Appendix 1. (Continued).



LÉGENDE / *LEGEND:*



Appendix 1. (Continued).

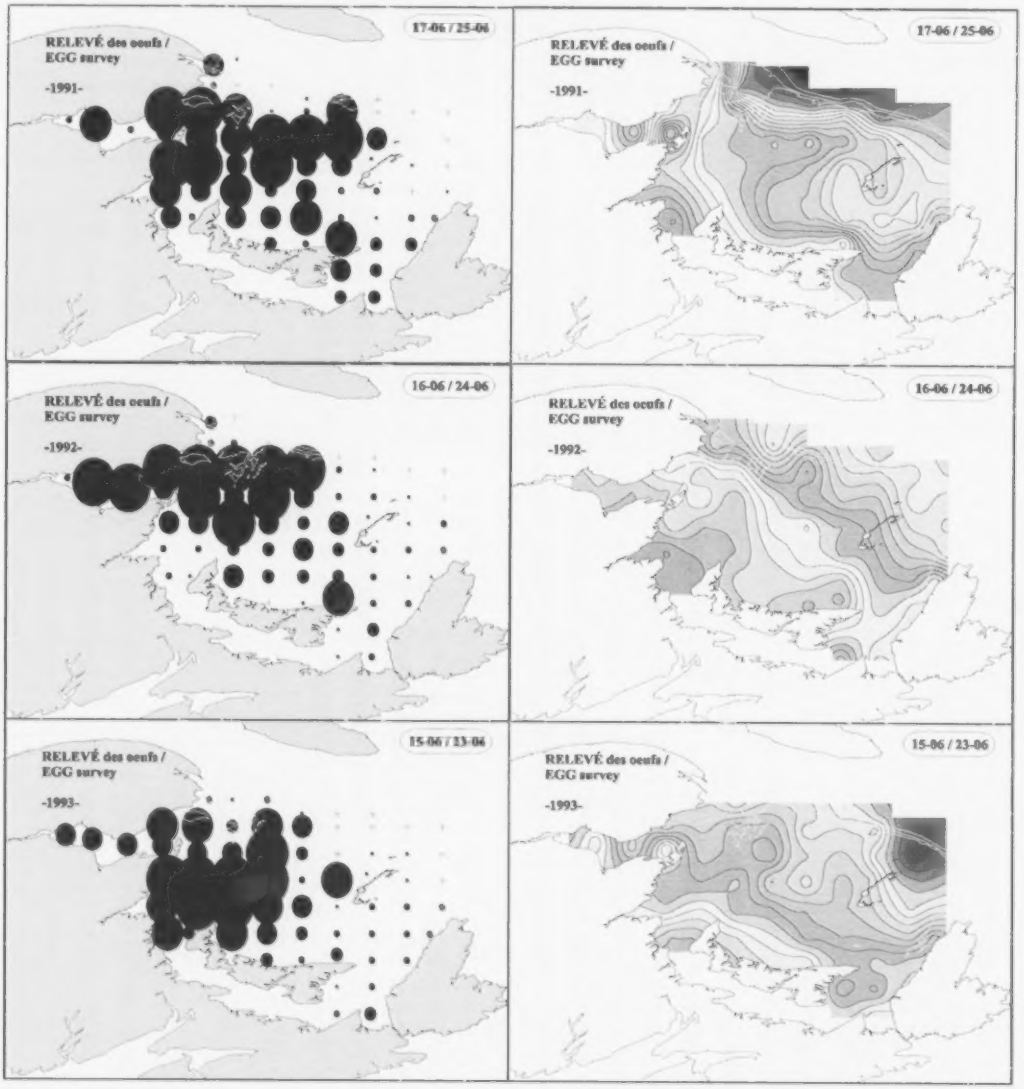


LÉGENDE / *LEGEND:*

0 · 1-10 · 10-100 · 100-200 · 200-500 · 500-1000 · >1000 n/m^2

4 5 6 7 8 9 10 11 12 13 14 15 16 17°C

Appendix 1. (Continued).



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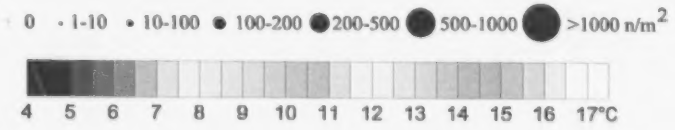

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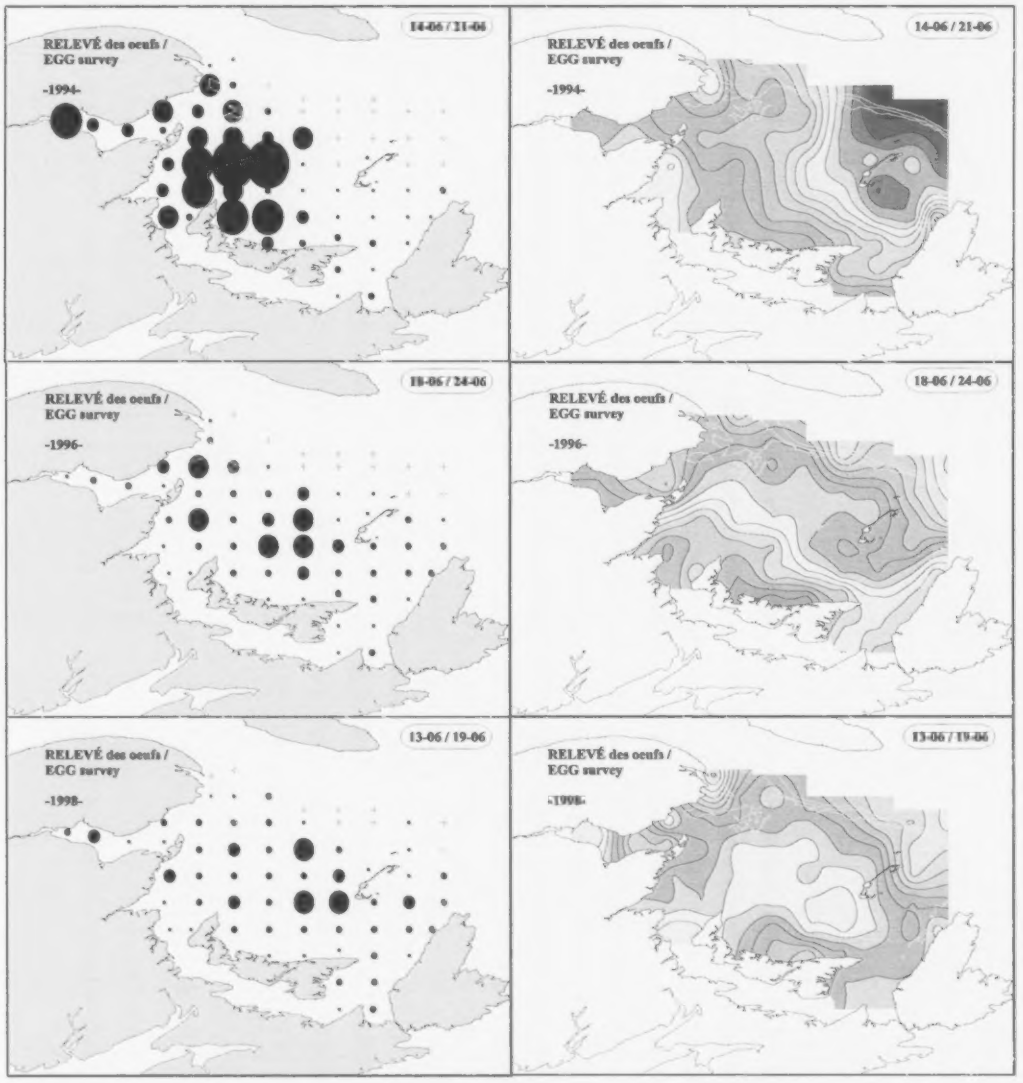

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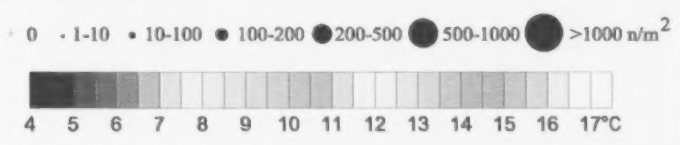

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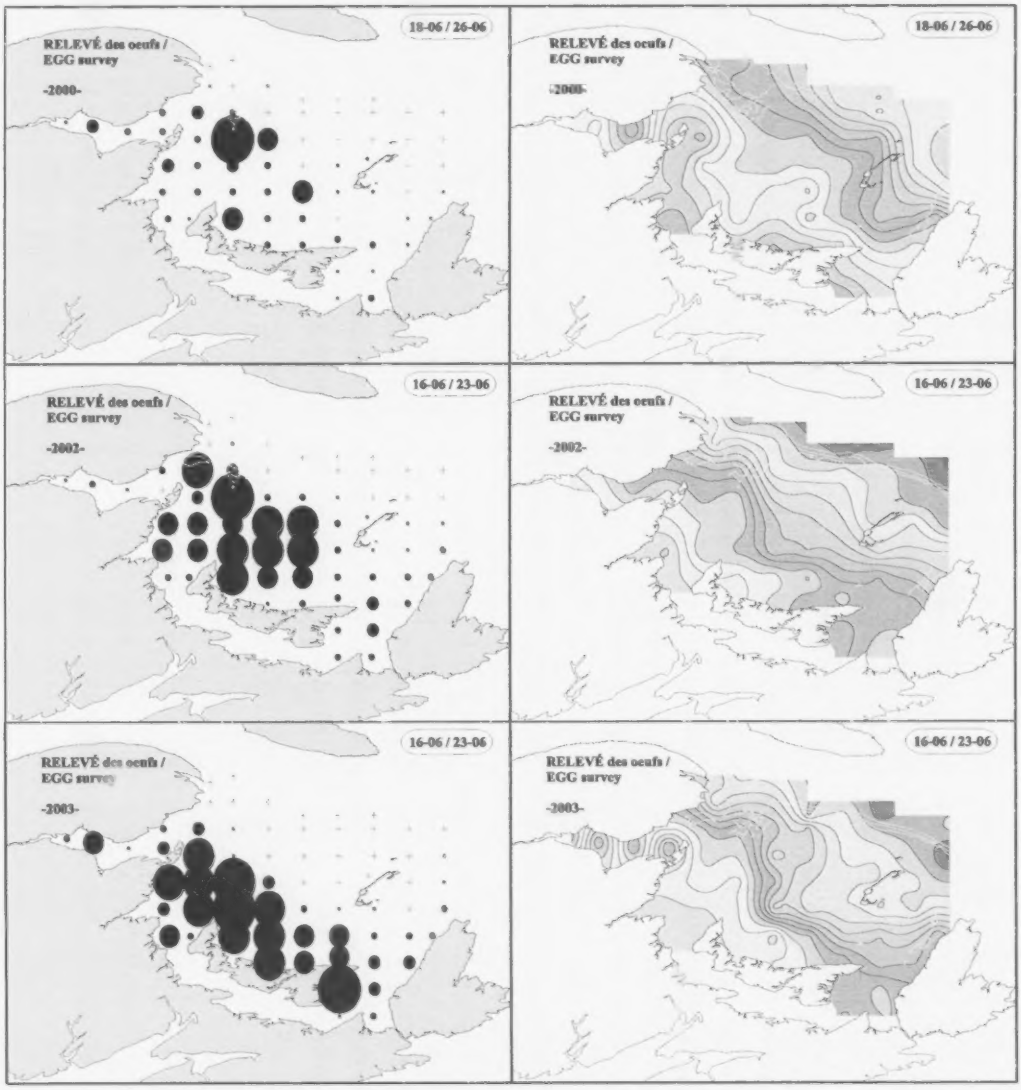
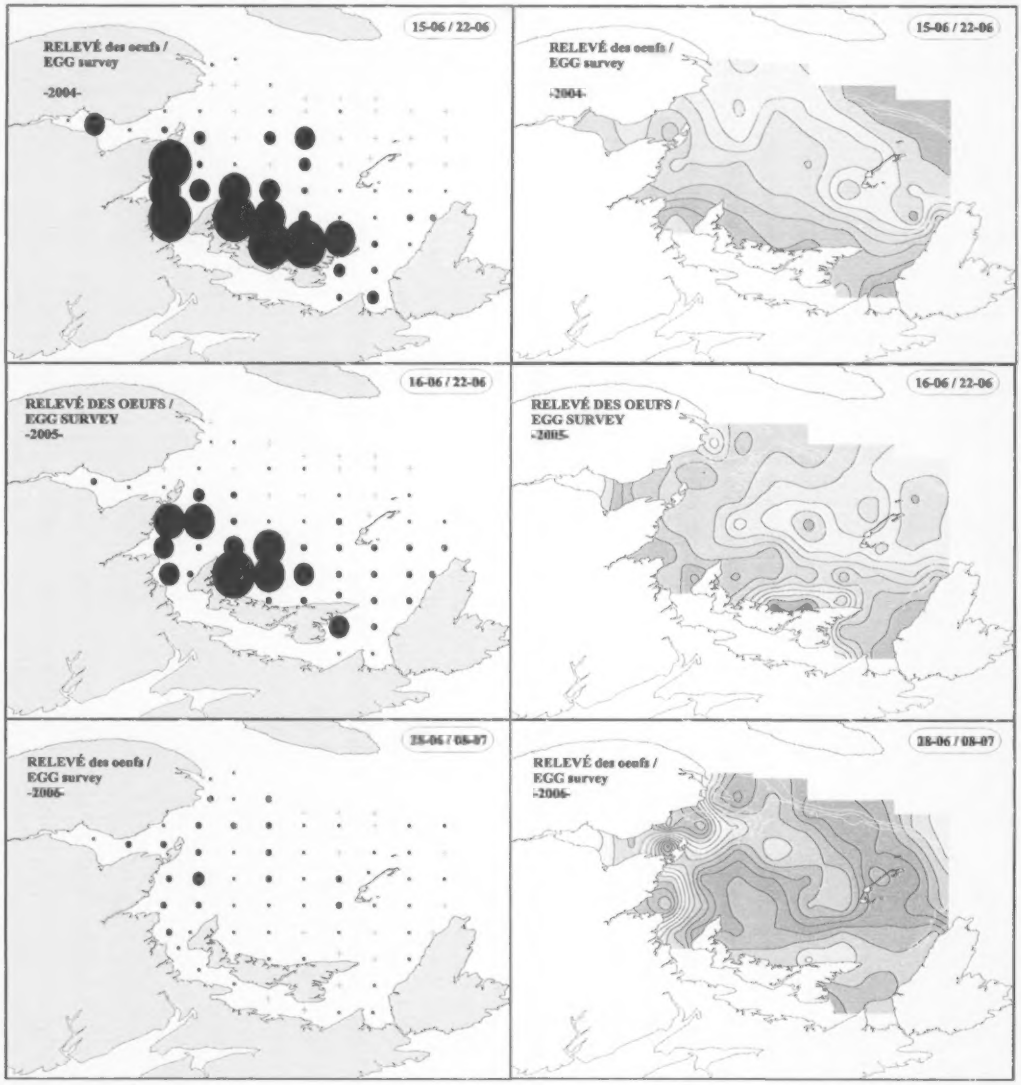


LÉGENDE / *LEGEND:*

0 · 1-10 • 10-100 ● 100-200 ● 200-500 ● 500-1000 ● >1000 n/m^2

4 5 6 7 8 9 10 11 12 13 14 15 16 17°C

Appendix 1. (Continued).

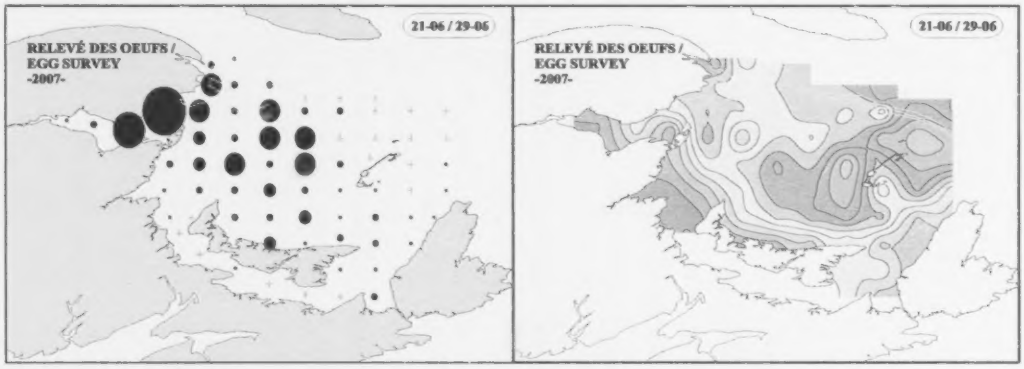

15-06 / 22-06
RELEVÉ des oeufs / EGG survey -2004-
15-06 / 22-06
RELEVÉ des oeufs / EGG survey -2004-
16-06 / 22-06
RELEVÉ DES OEUFS / EGG SURVEY -2005-
16-06 / 22-06
RELEVÉ DES OEUFS / EGG SURVEY -2005-
25-06 / 08-07
RELEVÉ des oeufs / EGG survey -2006-
28-06 / 08-07
RELEVÉ des oeufs / EGG survey -2006-

LÉGENDE / *LEGEND:*

0 · 1-10 • 10-100 ● 100-200 ● 200-500 ● 500-1000 ● >1000 n/m^2

4 5 6 7 8 9 10 11 12 13 14 15 16 17°C

Appendix 1. (Continued).

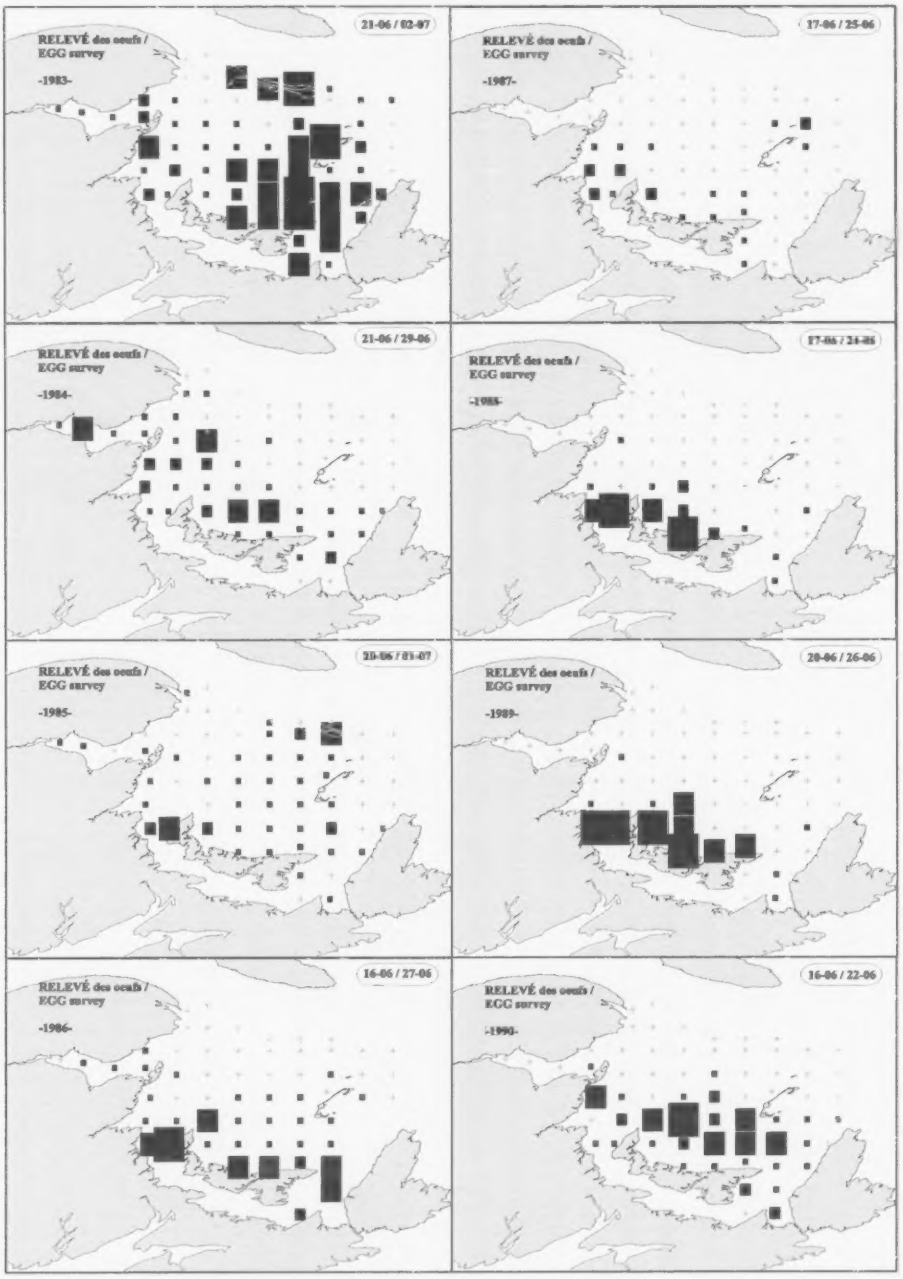


LÉGENDE / *LEGEND:*

0 · 1-10 • 10-100 ● 100-200 ● 200-500 ● 500-1000 ● >1000 n/m^2

4 5 6 7 8 9 10 11 12 13 14 15 16 17°C

Appendix 2. *Distribution of the Atlantic mackerel larvae abundances (n/m^2) for the research surveys conducted in the southern Gulf of St. Lawrence between 1983 and 2007.*



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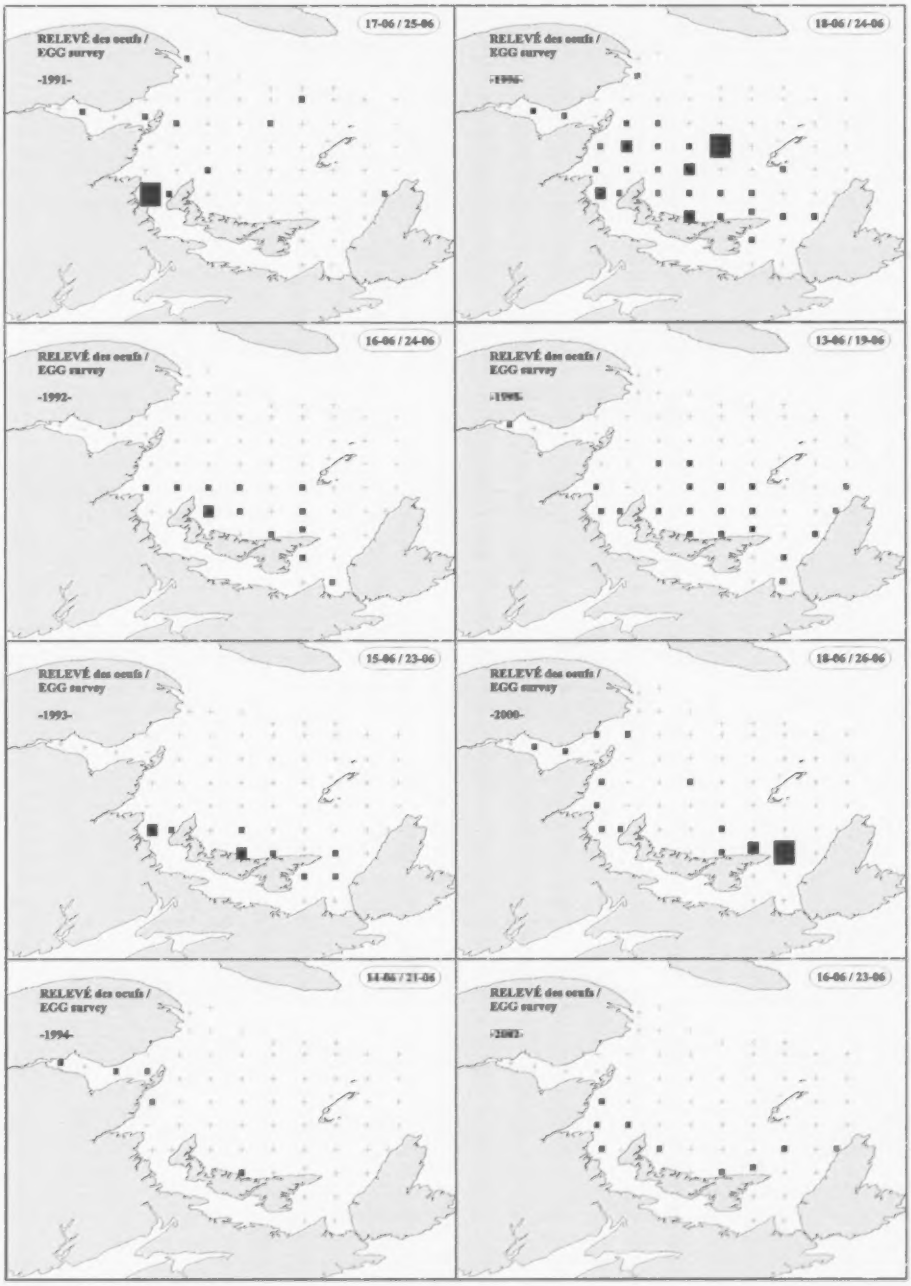

Appendix 2. (Continued).